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OAK RIDGES MORAINE AGGREGATE RESOURCES STUDY

BACKGROUND STUDY NO. 10 TO THE OAK RIDGES MORAINE AREA PLANNING STUDY

Prepared for

The Oak Ridges Moraine Technical Working Committee

by

The Oak Ridges Moraine Aggregate Committee

MAY 1994

May 1994

OAK RIDGES MORAINE
AGGREGATE RESOURCES STUDY
"Background Study No. 10 to the Oak Ridges Moraine Area Planning Study"

This background study was prepared for the Oak Ridges Moraine Technical Working Committee by an Oak Ridges Moraine Planning Committee comprising membership from the Aggregate Producers Association of Ontario (APAO), the Ministry of Natural Resources (MNR), and the Ministry of Transportation of Ontario (MTO).

It was developed to assist the Technical Working Committee in preparing a long term strategy to protect and manage the Oak Ridges Moraine Area. The strategy, when completed, will be submitted to the Minister of Natural Resources for consideration by the Government of Ontario.

This study is one of 15 background studies intended to collect data and examine planning and management issues essential to the development of a strategy for the Moraine. The data, recommendations, observations and conclusions within this report are those of the authors, who recognize that the Committee will use this material for guidance in developing its strategy, but that **the Committee may accept, reject or modify any proposed action or direction identified in this study.**

R. M. Christie
Chairman
Oak Ridges Moraine Technical Working Committee

Government Publications

NOTE TO THE READER ABOUT FIGURES IN THIS REPORT

This report contains a number of Figures that were reproduced in colour in the original report submitted to the Oak Ridges Moraine Technical Working Committee. To reduce production costs, the colour figures have been reproduced in black and white: however, some detail has been lost due to the complexity of the data presented.

Colour copies of 29 of the figures are available at an additional cost. For further information about colour copies, please contact:

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A colour copy of the report has also been sent to each of the following MNR Offices:

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Central Region, Brendale Square, Manominee Street, Huntsville, Ontario (705-789-9611)
Northwest Region, Suite 221, 435 South James Street, Thunder Bay, Ontario (807-475-1261)
Northeast Region, 140 4th Avenue, Cochrane, Ontario (705-272-7014)
Maple District, 10401 Dufferin Street, Maple, Ontario (905-832-2761)
Cambridge District, 605 Beaverdale Road, Cambridge, Ontario (519-658-9355)
Midhurst District, Midhurst, Ontario (705-725-7500)
Tweed District, 255 Metcalfe Street, Tweed, Ontario (613-478-2330)
Bancroft District, Highway #28, Bancroft, Ontario (613-332-3940)
Aylmer District, 353 Talbot Street West, Aylmer, Ontario, (519-773-9241)
Kemptville District, Concession Road, Kemptville, Ontario (613-258-8204)
Sudbury District, 3767 Highway #69 South, Suite #5, Sudbury, Ontario (705-522-7823)
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ACKNOWLEDGEMENTS

A number of individuals, in addition to the members of the Oak Ridges Moraine Aggregate Committee (ORMAC), contributed to the study. They include: numerous individual aggregate producers who provided key data on their respective operations and production, and district staff of the ministries of Natural Resources (MNR), Northern Development and Mines (MNDM), and Transportation (MTO) who provided data on the distribution of resources, licenses, wayside pits (waysides), upcoming construction and other information. The following individuals contributed to the written text of the report and/or provided data, and helped with the Oak Ridges Moraine (ORM) tour:

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Wes Green, MTO
Rob Cook, APAO
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Dana Hewson, Standard Aggregates Inc.
Ross Kelly, MNDM

The above contributions and the input from the Oak Ridges Moraine Technical Working Committee are gratefully acknowledged.

EXECUTIVE SUMMARY

Aggregates are Essential

Aggregates are an important non-renewable resource that is essential to the economy and infrastructure of the Greater Toronto Area (GTA). Aggregate Extraction has co-existed with other land uses on the Oak Ridges Moraine for over 100 years. Public need, available supply, environmental protection and rehabilitation measures are key components to ensure the sustainable utilization of aggregate resources from within the Oak Ridges Moraine.

Need for Aggregates

Over a five-year period (1986-90), the need for aggregate products in the GTA has averaged 64 million tonnes per year of which 60% (on average, 38 million tonnes per year) has been produced within the GTA. Of this amount, an average of 11 million tonnes, all sand and gravel, represents 50% of the 22 million tonnes of sand and gravel produced in the GTA annually over that five-year period. The annual need within the GTA is projected to reach 80 million tonnes by the year 2000 and 87 million tonnes by the year 2006. Road construction and maintenance use more than 50% of the total aggregate production. Recycling and alternative materials will not significantly reduce the demand for aggregates.

Transportation

Compared to other commodities, such as base and precious metals, aggregate is a high volume/low unit cost resource. Transportation cost is often more than 50% of the delivered cost and is therefore the most significant component of the total cost to the consumer. The importation of aggregate resources from more distant sources would result in increased economic, environmental and social impacts. Longer haulage would impact more people and cause increased fuel consumption resulting in additional polluting emissions. These impacts are minimized by utilizing resources which are closest to the consumer, such as those in the Oak Ridges Moraine.

Potential Aggregate Resources

The report focuses on the availability of potential resource areas for licensing and on the current reserves within existing licensed properties. Potential resource areas are not all available for consideration for licensing. Other land uses and environmental constraints have precluded the future licensing and use of a significant portion of these potential resource areas. The report contains a demonstration of the impact of these constraints by analyzing the availability of potential resource areas in the Town of Whitchurch-Stouffville and the Township of Manvers. Gravel deposits of primary significance are potential sources for quality aggregates for high specification uses such as concrete and hot mix asphalt. Sand

and gravel deposits of secondary significance are also potential sources for lower quality aggregates needed for roads and other construction projects.

Existing Aggregate Reserves

The current supply of aggregates consists of aggregate reserves within existing licensed properties. For operations on the Oak Ridges Moraine, it is anticipated that at current rates of aggregate production, many of these operations will have depleted their existing reserves within about 16 years. To ensure an uninterrupted and affordable supply of aggregates, a much longer term perspective is necessary and planning initiatives to secure adequate supplies are required. The Oak Ridges Moraine is the most significant area of potential sand and gravel resources to supplement current supplies.

Licensing

The majority of the licences within the moraine predate the introduction of regulatory controls on extraction in the early 1970s. Comparatively few licences have been issued since then, such that the annual consumption of reserves has significantly exceeded replacement by new licensed reserves. The time requirement (3 to 8 years), the difficulty (public opposition) and the cost of the licensing and approval process are very serious impediments to ensuring future resource availability.

Environmental Protection

The aggregate industry is highly controlled by a regulatory framework, which provides a comprehensive assessment of potential impacts and provisions for mitigation of environmental impacts. These impacts are being further minimized through improved technologies.

Aggregate extraction in the ORM does not include site "dewatering" (i.e. lowering of the water table) and recent monitoring (Ministry of Environment and Energy's MISA Program) has confirmed that water discharges from aggregate operations elsewhere in Ontario are clean and safe. The hydrogeological impacts of extraction on the moraine are the subject of another background study.

Rehabilitation

There are excellent examples of site rehabilitation on the moraine. The Aggregate Resources Act's requirements for progressive rehabilitation ensure the interim nature of these operations. A major aim of progressive rehabilitation is to minimize the disturbed areas and to return depleted sites to after uses that are compatible with and enhance long-term land use and environmental objectives. Pre-planned, progressive rehabilitation provides an opportunity to create new landscapes including the ability to maximize ecosystem biodiversity, wetland creation and a return to natural systems.

Balanced Approach

The recommendations in the report are based on an assessment of need, supply and environmental aspects associated with aggregates. The recommendations promote a "balanced approach" for a planning strategy for the ORM where the need for the resource is recognized, continued availability is provided for and appropriate environmental controls protect important natural features and ensure the health of ecosystems, all for the long-term benefit of the residents of Ontario.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF STUDY

To achieve the Oak Ridges Moraine Technical Working Committee's (ORMTWC) mandate of developing a long-term planning strategy, they identified the need for various background studies.

The moraine contains substantial deposits of mineral aggregates, specifically sand and gravel. Some of these deposits have made and will continue to make a significant contribution to meeting the demand for these basic construction materials, particularly in the Greater Toronto Area (GTA). Background Study No. 10 examines the need for, and supply of, the aggregate resources of the moraine. The study analyzes the nature of the aggregate industry and the extensive legislation that regulates the location and operation of the industry. It also examines the opportunities for incorporating aggregate extraction within an overall strategy sensitive to the protection and enhancement of the ecological integrity of the Oak Ridges Moraine (ORM).

The Oak Ridges Moraine Aggregate Committee Study Team, at the request of the ORMTWC, prepared a Terms of Reference which were adopted by the ORMTWC in January 1992, and subsequently revised in April 1993 (Appendix A).

1.2 OAK RIDGES MORAINE AGGREGATE STUDY TEAM

The Oak Ridges Moraine Technical Working Committee recognized that the majority of the data required to complete a study of this nature would be drawn predominantly from the aggregate industry and the ministries of Natural Resources and Transportation. In late 1991, the Technical Working Committee approached the Aggregate Producers' Association of Ontario (APAO) and the ministries of Natural Resources (MNR) and Transportation (MTO) to collaborate on the study and report back to the ORMTWC. A joint committee drawing its membership from these three organizations was formed to oversee the collection and collation of data and preparation of the report. The following is the list of Oak Ridges Moraine Aggregate Committee (ORMAC) team members:

Gary Brown, APAO, ORMAC Chair and member ORMTWC
Denis Schmiegelow, APAO & alternate member ORMTWC
Rob Cook, APAO
Doug Vanderveer, MNR
Brian Messerschmidt, MNR
Zoltan Katona, MTO
Dennis Billings, MTO
Wes Green, MTO

1.3 PRESENTATIONS TO THE OAK RIDGES MORAINE TECHNICAL WORKING COMMITTEE

ORMAC recognized that there would be a large volume of information generated by this background study, some of which would be of a technical nature. For this reason ORMAC arranged a series of presentations to the ORMTWC to share this data and any preliminary findings as they became available. This interaction with the ORMTWC was designed with two purposes in mind. First, the presentations would provide the ORMTWC members with information in manageable amounts. Secondly, it would provide an opportunity for interaction between the two committees and for the ORMAC to address specific questions or concerns raised by the ORMTWC during the background study. A series of four slide presentations were made to the ORMTWC between June, 1992 and March, 1993. ORMAC also organized a field tour for members of the ORMTWC. The Oak Ridges Moraine Aggregate Tour (ORMAC, unpublished report, 1992) visited a variety of active aggregate extraction operations including some of the largest producers on the moraine. A number of former licensed properties and rehabilitated wayside pits were also visited. The presentations and field tour provided an opportunity for the members of the ORMTWC to gain an understanding of the nature of the industry and its operations. Government's regulatory role under the Aggregate Resources Act and its various resource management functions on both licensed and temporary extraction sites were also discussed.

1.4 DESCRIPTION OF THE AGGREGATE STUDY AREA

ORMAC, in attempting to present a balanced approach on the issues of aggregate extraction and an assessment of the need for continued access to the ORM(GTA) aggregate resources, found it necessary to present data on resources beyond the immediate bounds of the ORM(GTA). This enlarged "Aggregates Study Area" (Figure 1) is used to place the production and availability of resources of the ORM(GTA) within the larger context of the GTA and to encompass the Oak Ridges Moraine as a whole. It also includes other areas that could either currently, or in the future, supply aggregates to the GTA, as the economy and aggregate distribution infrastructure permit. Chapter 2 (Need) and Chapter 3 (Supply) provides more specific detail for select sub-components of the Study Area, specifically:

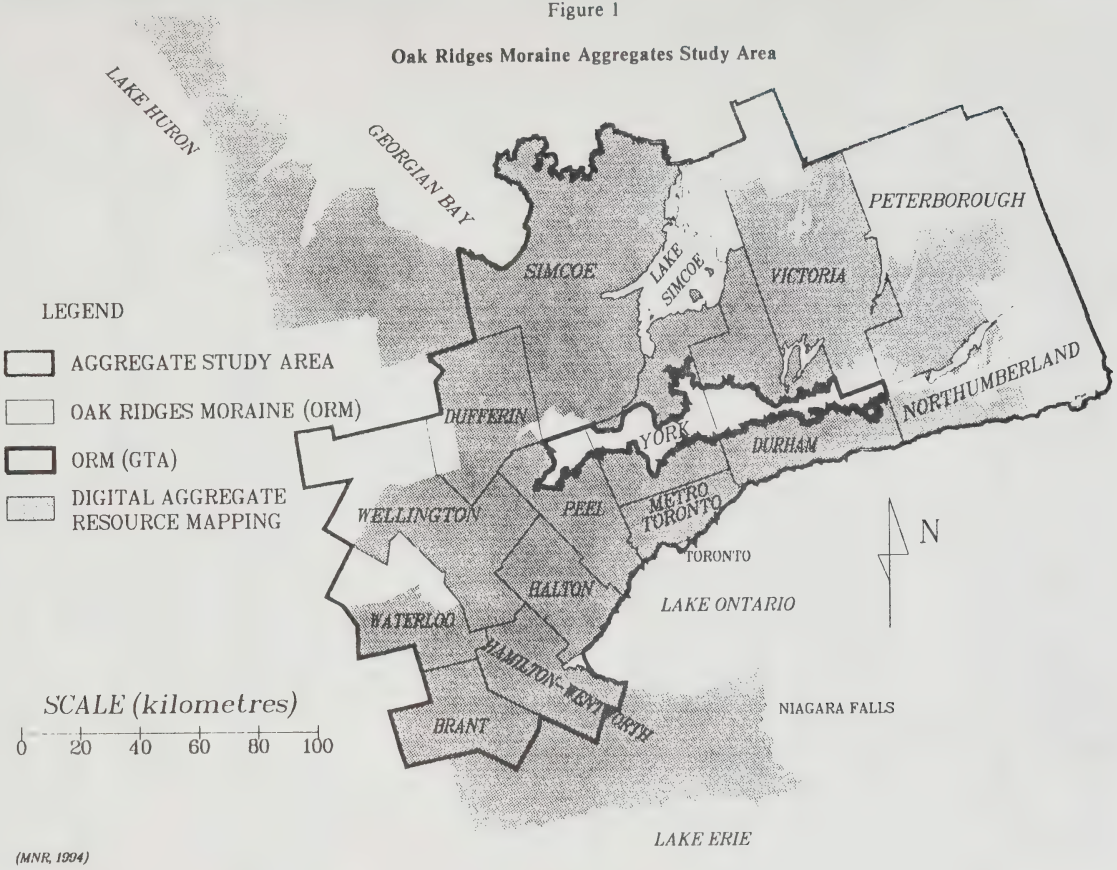
* the Oak Ridges Moraine (ORM)
* the Greater Toronto Area (GTA)
* the Oak Ridges Moraine, GTA portion (ORM(GTA))

The Aggregates Study Area has a total area of approximately 2.8 million hectares (2,846 sq. km) and encompasses the GTA (702,440 hectares, 702 sq. km) and regional municipalities/counties of:

*	Dufferin	(149,019 hectares)
*	Peterborough	(394,256 hectares)
*	Northumberland	(209,325 hectares)
*	Victoria	(306,690 hectares)

Figure 1

Oak Ridges Moraine Aggregates Study Area



(MNR, 1994)

* Simcoe (480,000 hectares)
* Brant (91,662 hectares)
* Wellington (265,931 hectares)
* Waterloo (134,270 hectares)
* Hamilton-Wentworth (112,136 hectares)

The GTA consists of the regional municipalities of:

* Halton (98,305 hectares)
* Peel (126,251 hectares)
* York (171,869 hectares)
* Durham (242,184 hectares)
* Metropolitan Toronto (63,831 hectares)

The number in brackets is the area of each municipality (Municipal Directory, 1993).

The ORM:

* crosses a central portion of the Aggregates Study Area
* extends from the east part of Caledon to southeast of Peterborough
* has a total area of approximately 194,568 hectares (194.6 square km)

The ORM(GTA):

* consists of 128,139 hectares (66 percent of the ORM)
* is restricted to the GTA and the regional municipalities of

  - Peel
  - York
  - Durham

1.5 REPORT FORMAT

The report consists of six chapters. The main body of the report is contained in Chapters 2 to 4 which address aggregates from the perspective of:

* Need (Chapter 2)
* Supply (Chapter 3)
* Balancing Society's Needs: Aggregates and the Environment (Chapter 4)

A summary follows at the end of each of these chapters.

Data from a survey of aggregate operators (Appendix B) is included in Chapter 2. Conclusions based on the survey are subject to modification when updated or new

information (e.g. licensed reserves) becomes available.

The aggregate resource and land use information (Chapter 3) and the locations of abandoned pits (Chapter 4) were compiled by the Ministry of Natural Resources (Resource Stewardship and Development Branch) using a Geographic Information System (GIS). Despite efforts to ensure data accuracy, some errors or limitations may exist in the mapped compilations and the reader should refer to the original sources of the information (e.g. ARIPs, licensed operators), particularly if the data is to be used in a manner that differs from that intended in this report.

Chapter 5 discusses the overall conclusions on resource demand, availability and the role of the ORM(GTA). The joint recommendations of the ORMAC membership to the ORMTWC on balancing the demand for access to new resource areas on the moraine with an overall land use planning strategy for the ORM(GTA) are contained in Chapter 6.

References and Appendices referred to in the report follow the main text of the report. The appendices make up a substantial portion of the total report. ORMAC wished to ensure the reader had access to all relevant information but was not overwhelmed with detailed and technical data which is presented in the appendices.

2.0 NEED

2.1 AGGREGATE USE

2.1.1 Definition of Aggregates

The term "aggregate/s" refers to sand, gravel, crushed rock/stone, or any combination of these, whether in their natural or processed state. The term as used in the Aggregate Resources Act is more formally defined as:

> *"Aggregate" means gravel, sand, clay, earth, shale, stone, limestone, dolostone, sandstone, marble, granite, rock other than metallic ores, or other prescribed material.*

Aggregates are a unique commodity in that aggregates:

* are not present everywhere
* occur as discreet deposits resulting from specific geological events
* consist of consolidated materials related to bedrock formation
* are unconsolidated materials derived from the deposition of materials associated with glacial or fluvial processes

The aggregates of the Oak Ridges Moraine are composed of unconsolidated materials, predominantly sand and gravel deposits. Bedrock in the ORM does not occur close enough to the surface to support economic aggregate extraction. The general description of the geology and the relationship between the geology and deposition of the sand and gravel deposits of the moraine are provided in Chapter 3.

2.1.2 Some Facts About Aggregates and Use

Aggregates are non-renewable and there are no other substitutes available that are of the same quality and in the quantities required to replace the need for natural aggregates. Aggregates are used as the basic structural material in the construction of:

* roads, highways, bridges, sewers, airports, parking lots
* residential houses, commercial and industrial buildings
* storm water management, acid rain and agricultural soil treatments

Aggregates touch all aspects of our social and economic activities. They are a fundamental ingredient required for the basic infrastructure necessary in the transportation of goods and services to markets, both in Canada and the United States.

Some interesting facts about general sand and gravel usage in Ontario are:

* More than 50 percent of sand and gravel production goes into road and highway construction (Table 1).

* The majority of road and highway construction cost is borne by the province and the municipalities.

* The next major use of sand and gravel (18 percent) is in concrete products manufactured for a wide range of uses.

Table 1

Uses of Sand and Gravel in Ontario

Roads	53%
Concrete Aggregate	18%
Fill	14%
Asphalt Aggregate	7%
Mortar Sand	2%
Other Uses	6%
TOTAL	100%

Source: Natural Resources Canada (Energy, Mines and Resources)

* Most aggregates require some form of on-site processing before they can be used in construction.

* An average size home requires about 440 tonnes of aggregates.

* An average size school requires almost ten times this amount or about 4000 tonnes.

* A single lane of highway, one kilometre long, requires 7,000 to 12,000 tonnes of aggregate.

* On average in Ontario, MTO has used more than 10.3 million tonnes of aggregates per year over the four-year period 1988-1991.

* Ontario's municipal aggregate use is six times MTO's use or approximately 60 million tonnes per year.

* There are 21,500 kilometres of provincial highways, 125,000 kilometres of municipal roads and 31,000 kilometres of forest access roads in Ontario.

* There are 2,950 concrete and steel structures along the provincial highway system and over 8,600 municipal bridges.

* The growth rate for travel on Ontario's highways increased more than 26 percent between 1984 and 1988, while Ontario's population during the same period grew by seven percent.

* On a typical day, 130 million vehicle kilometres are travelled on Ontario's provincial highways and 71 million vehicle kilometres travelled on municipal roads.

* In the GTA, work trips account for 46 percent of the daily total travel (8.76 million trips).

* 94 percent of all Ontarians use the provincial highway system on a regular basis.

The Metropolitan Toronto and surrounding area included in MTO Central Region (Figure 2):

* occupies less than two percent of the province's total land area
* contains over 16 percent or slightly more than 8,000 lane kilometres of the provincial highway total
* received in fiscal 1991, 37 percent of the total provincial highways capital monies
* contains more than 5 million persons or about 55 percent of the province's total population of 10 million people

2.1.3 History of the Aggregate Industry in the Oak Ridges Moraine

Aggregate resource extraction has co-existed with other land uses on the Oak Ridges Moraine for over one hundred years. The following is a brief outline of the industry's history:

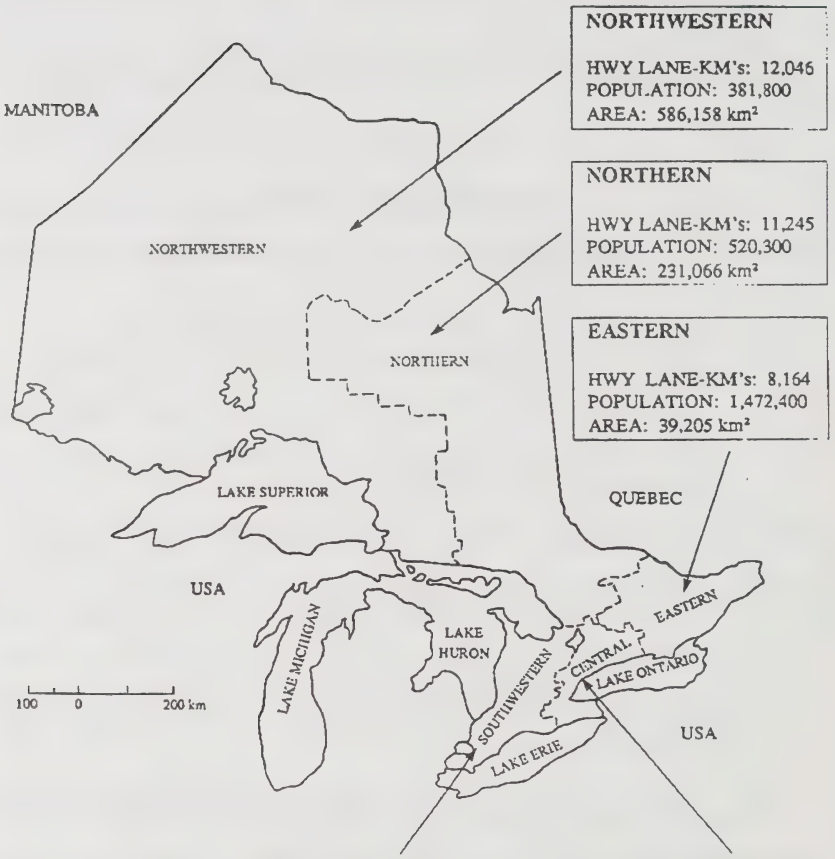
* In the mid 1800s to the early 1900s, resource extraction was primarily located close to towns and villages due to the limitations of both the transportation network and modes of transportation.

* There were many small individual extraction operations with limited production due to extraction either occurring manually or aided only by rudimentary machinery.

* As communities in urban areas within and adjacent to the ORM continued to grow during the period 1920 to 1950, there was a corresponding increase in aggregate resource extraction.

The aggregate resources of the ORM developed from regional to provincial significance during the post-World War II economic and population surge in southern Ontario. This

Figure 2
Ministry of Transportation Regions and Corresponding 1991 Ontario Demographic Data



enhanced regional significance was facilitated by:

* an increased urban demand for the materials
* a more efficient transportation system for the delivery of the materials to the consumer
* the depletion of other closer to market aggregate sources within the GTA, most notably the shoreline beach deposits of post-glacial Lake Iroquois

Provincial regulation of the aggregate industry commenced with the introduction of the Pits and Quarries Control Act (PQCA) in 1971. All extraction operations in areas of the province designated under the Act were required to be licensed if they wished to continue to operate.

Within the ORM(GTA):

* the majority of existing operations started prior to any regulation of the industry (Figure 3a)
* there have been only 12 new operations licensed in the ORM(GTA) (Figure 3b) since 1974

As demand increased in the GTA, the nature of extraction operations evolved in several ways:

* Fewer sites produced larger volumes as the economy of scale and the introduction of licensing in 1970 influenced resource extraction operations.

* Advances in technology (extraction and transportation) allowed for the development of resources further removed from local towns and villages.

* Technological advance became significant in all areas of resource development (extraction, processing, shipping and rehabilitation) and allowed for the utilization of resources throughout the ORM.

* Technological advances also encouraged better resource management through the utilization of more marginal resources and deposits.

* Aggregate resource extraction evolved into an "industry" as consumer demand increased and market areas expanded.

The trend towards larger operations continues today due to the significant capital investment required for new operations and the rigorous land use controls and licence approval process now in place.

Figure 3

Extraction Operations and Licensing in the ORM(GTA)

Figure 3(a): Number of Operations Commenced per 10-Year Period

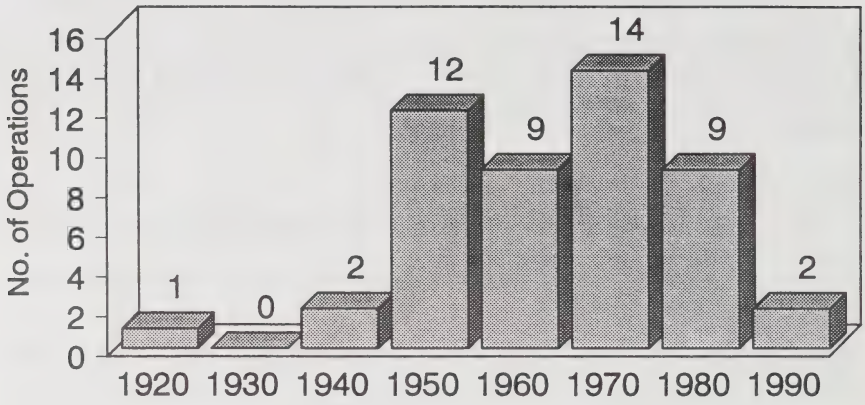
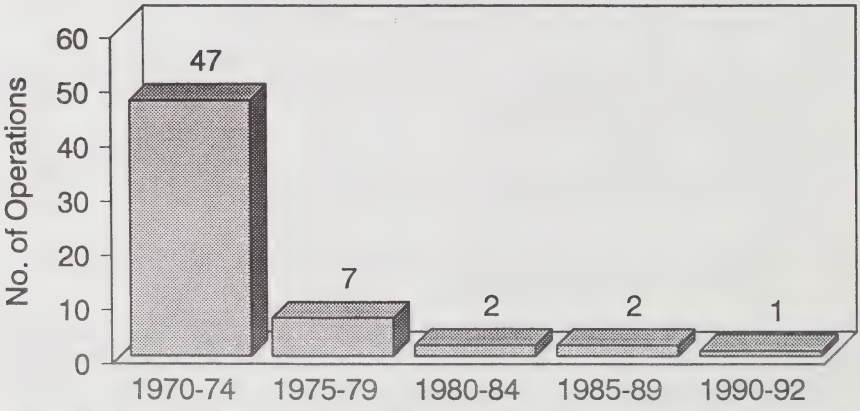


Figure 3(b): Number of Licences Issued per 5-Year Period (1970-74 includes operations existing prior to licensing under the PQCA)



Note: The data in these figures is based on the 59 responses to the Aggregate Producers' Operator Survey (Appendix B, Table B-1). Some operations (Figure 3a) include more than one licence.

The total production of aggregate between 1986 and 1991 is shown in Table 2. The table shows that:

* Ontario production peaked at 197 million tonnes in 1988 and 1989.

* GTA and ORM production peaked in 1988 at 44 and 17 million tonnes, respectively.

Production was substantially lower in 1990 and 1991 in the GTA and ORM due mainly to the lack of economic growth; however, the share of Ontario's aggregate production provided by:

* the Aggregates Study Area has decreased more rapidly than the overall Ontario production (i.e. share since 1987 decreased from 50 to 41 percent)

* the ORM has decreased from 10 to 7 percent but this is much less than the decrease in the GTA's share which dropped from 24 percent in 1986 to 14 percent in 1991

Table 2

Aggregate Production for Ontario, Aggregates Study Area, GTA, ORM and ORM(GTA)

	1986	1987	1988	1989	1990	1991
Production (million tonnes)						
Ontario Total[1]	165	185	197	197	161	135
Aggregates Study Area[2]	81	92	94	94	73	55
Greater Toronto Area (GTA)	39	43	44	38	28	19
Oak Ridges Moraine (ORM)	16	17	17	16	12	9
ORM (GTA)	11	12	12	11	8	5
Share of Ontario Production						
Aggregates Study Area[2]	49%	50%	48%	48%	45%	41%
Greater Toronto Area (GTA)	24%	23%	22%	19%	17%	14%
Oak Ridges Moraine (ORM)	10%	9%	9%	8%	7%	7%
ORM (GTA)	7%	6%	6%	6%	5%	4%

[1] Total aggregate production includes crushed stone, sand and gravel, clay, shale and other stone.
[2] Excludes minor production from non-designated private lands and Crown land aggregate permits.

Accurate statistics are not available prior to 1986 on the breakdown of licensed sand and gravel and crushed stone production. A comparison of production of sand and gravel and crushed stone from bedrock for the GTA, ORM and Ontario is shown in Table 3.

Table 3

Licensed and Wayside Aggregate Production by Commodity for Ontario, Aggregates Study Area, GTA, ORM and ORM(GTA)

	1986	1987	1988	1989	1990	1991
Sand and Gravel (million tonnes)						
Ontario Total*	NA	NA	90	93	80	64
Aggregates Study Area	54	59	52	61	47	37
Greater Toronto Area (GTA)	24	25	23	21	16	11
Oak Ridges Moraine (ORM)	16	17	17	16	12	9
ORM (GTA)	11	12	12	11	8	5
Crushed Stone (million tonnes)						
Ontario Total*	NA	NA	59	56	52	40
Aggregates Study Area	27	32	25	23	24	15
Greater Toronto Area (GTA)	15	17	15	14	11	7
Oak Ridges Moraine (ORM)	0	0	0	0	0	0
ORM (GTA)	0	0	0	0	0	0
NA = data not available						

Note: Table excludes clay, shale and other stone production as well as production from non-designated private lands and Crown land aggregate permits; total will be less than Ontario total in Table 2.

The ORM and ORM(GTA) remain a significant supply source of sand and gravel to the GTA as shown by the following:

* The ORM's share of the Aggregates Study Area's sand and gravel production has averaged 28 percent between 1986 and 1991

* The GTA's share of the Aggregates Study Area's sand and gravel production has declined from 44 percent in 1986 to under 30 percent in 1991

* The ORM(GTA)'s share of the Aggregates Study Area's sand and gravel production peaked at 23 percent in 1988 and then decreased to about 13 percent in 1991

* The ORM(GTA)'s share of GTA sand and gravel production has averaged 49 percent between 1986 and 1991.

These figures indicate that the GTA (the main consuming centre) is increasingly relying on materials beyond its boundaries and that increasing amounts of this material are coming from the ORM outside the GTA. This would explain why the overall ORM share of production for the Aggregates Study Area has been constant while ORM(GTA) share has decreased by 10 percent since 1988. From an economic, social and environmental viewpoint, it is impractical to place increasing or total reliance on aggregate supplies outside the GTA. The reasons for this are further discussed in Section 3.6.

2.1.4 Types of Licensed Operations and Products

All active aggregate operations licensed in the ORM are surface pits extracting unconsolidated materials and producing sand and gravel products except for:

* 3 operations producing clay liner or non-sand fill
* 1 operation producing both clay and sand materials

The depth to the bedrock beneath the ORM precludes the possibility of economically feasible quarry operations to extract consolidated bedrock materials.

The sand and gravel deposits associated with morainic deposition tend to be variable in terms of aggregate resource quality and quantity. This variability is evident both throughout the landform feature and within specific properties. To obtain the variety of materials necessary to meet product specification material, operators will blend materials:

* from various locations within a single licensed property; or
* from various depths within a single property.

All aggregate production from licensed sites within the ORM must be of sufficient quality:

* to meet strict specification requirements of consumer agencies and industries
* to demonstrate acceptable performance as a building material
* in the case of MTO, meet provincial standard specifications for quality requirements in its highway and road design (see Part 1 and 2, Appendix C)
* in the case of local and regional municipalities, many of MTO provincial standard specifications must be adhered to in order for these agencies to qualify for provincial road subsidies

Most aggregate sources including those in the ORM, cannot support the production of certain specification materials and this must be addressed in any resource management strategy.

A resource management strategy must:

* recognize that both high quality and low quality aggregate products are required to meet varied construction demands
* ensure that high quality resources are not misused to produce low quality aggregate products where lower quality materials would suffice

Table 4 is a listing of specification products expressed as a percentage of average annual production (1986-1991) for licensed operations within the ORM. Over 70% of ORM products are utilized in applications related to ready-mixed concrete, asphalt, granular base and winter sands.

Table 4

Specification Products as a Percentage of Annual Production (1986-1991)

Concrete & Asphalt Stone	12%
Concrete & Asphalt Sand	22%
Granular Base (A & M)	36%
Granular Sub-Base (B & Fill)	10%
Winter Sand	5%
Other	12%
Unmarketable Byproduct	3%
TOTAL	100%

Source: APAO Operator Survey (Appendix B, Table B-1)

The importance of the ORM as a source of sand and gravel is illustrated by its use in premium products such as asphalt and concrete and the blending of sand and gravel with imported quarried bedrock.

Resource blending can represent an efficient utilization of aggregate resources both within and outside the ORM.

The production of high quality materials for use in the ready-mixed concrete and asphalt industries requires the use of washing plants to remove clay and silt sized particles from the aggregate materials. Only four of the licensed properties within the ORM(GTA) are currently, or have approval for, operating washing plants.

2.2 MARKETS

2.2.1 Factors Affecting Production

Nearly all aggregate produced is for construction related purposes including the use of crushed rock in the manufacture of cement and ready mixed concrete. The factor that most affects the demand for aggregate production is the level of construction activity.

Construction activity is driven by the state of the economy and is most sensitive to:

* growth in the Gross Domestic Product (GDP)
* residential construction demand
* changes in the level of employment

As construction activity increases, so does the demand for aggregate as Figure 4 illustrates.

Transportation cost is a significant component of the delivered cost of aggregate. The cost of transportation:

* can exceed the price of aggregate at the plant site
* impacts decision-making with regard to development and production from more distant sources of aggregates

The average truck transportation cost for delivery of aggregates (Planning Initiatives Ltd., 1993):

* up to a distance of 32 km delivery is $0.15 per tonne per km (i.e. it costs $48.00 to deliver 10 tonnes 32 km)
* beyond 32 km, the minimum additional rate is $0.055 per tonne per km (i.e. to deliver 10 tonnes 50 km costs $57.90, and to deliver the same load 120 km costs $96.40)

To minimize the cost of aggregate, aggregate operations should be located as close to markets as possible.

2.2.2 Market Areas Supplied by the Oak Ridges Moraine

The percentage breakdown of the ORM production in terms of the distance shipped (APAO Survey, Appendix B) to market is as follows:

* 60 percent of all aggregate produced from the ORM(GTA) licences was shipped less than 50 km; only 22 percent was delivered beyond 50 km
* 50 percent of the aggregate produced from the remainder of the ORM was delivered within 50 km of production; 32 percent was shipped more than 50 km

Figure 4

Some Major Factors Affecting the Demand for Aggregate Production

Figure 4(a): Gross Domestic Product (GDP) for Ontario, 1976-1992

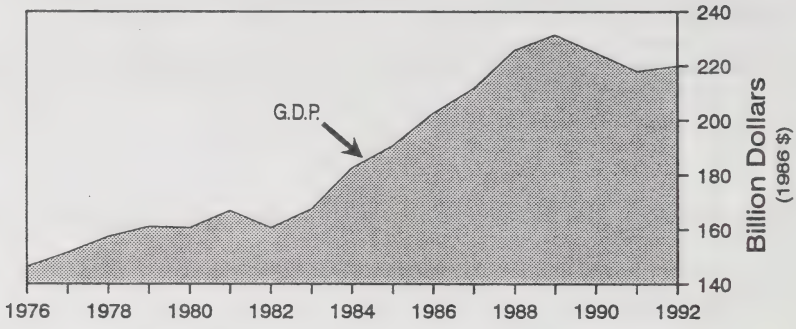
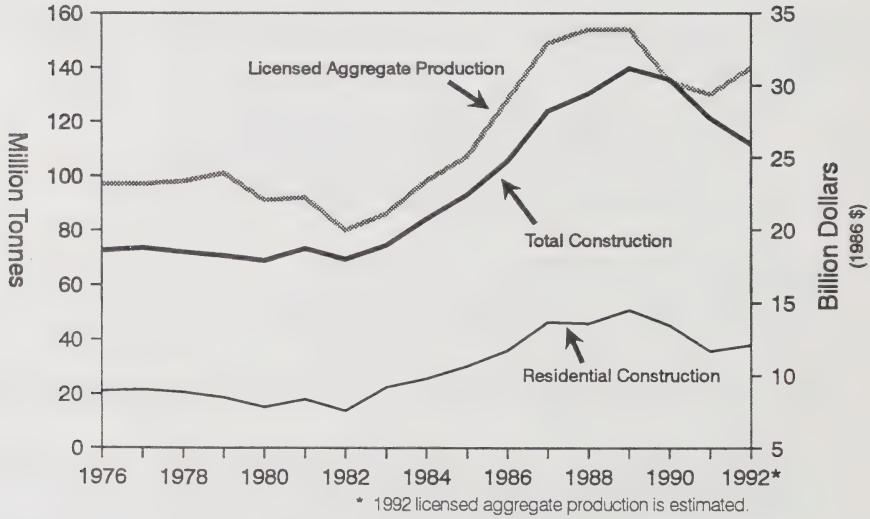


Figure 4(b): Construction Expenditures and Licensed Aggregate Production in Ontario



Note: Total Licensed production includes production of clay, shale and other stone excluded from Table 3.

* the remaining 18 percent was either used on site or picked up by customers for which haulage distances could not be established.

The shipping data highlights a unique nature of aggregate supply: that it is as much constrained by the economics of transportation distances as it is by regulatory limitations and requirements. Additional information on the transportation of aggregates and associated costs is provided in Chapter 3.

Urban centres continue to require aggregate material. The availability of aggregates in reasonable proximity to these urban areas has contributed to the establishment, development and growth of these centres. As these urban centres continue to grow, so will their demand for aggregate materials.

2.3 FUTURE NEED

2.3.1 Forecast for Ontario and the Greater Toronto Area

A forecast of aggregate demand is set out in the following table.

Table 5

Forecast Aggregate Demand for Ontario and the GTA

(Annual Projections Averaged for the Five-Year Period in Million Tonnes)

Year	Sand and Gravel		Crushed Stone		Total Aggregate	
	GTA	Ontario	GTA	Ontario	GTA	Ontario
1986-1990	37	111	27	70	64	181
1991-1995	36	105	26	65	62	170
1996-2000	42	119	30	73	72	192
2001-2005	46	128	33	81	79	209
2006-2010	50	139	37	87	87	226

Note: 1986-1990 numbers are actual production used as a baseline for the forecast. Sand and gravel and crushed stone numbers have been assumed to include all minor aggregates (clay, shale and other stone).

Source: A State of the Resource Study (Planning Initiatives Ltd., 1993), p. 4-15

The forecast in Table 5 uses an average annual 1986 to 1991 production of 181 million tonnes of all aggregate in Ontario and 65 million tonnes in the GTA as the baseline data for the projection of aggregate production.

By the period 2006 to 2010, the average annual demand for aggregate is forecast to increase to:

* 226 million tonnes for Ontario, an increase of almost 25 percent compared to the 1986 to 1990 period
* 87 million tonnes for the GTA, an increase of almost 34 percent compared to the 1986 to 1990 period

While the provincial economy has started to gradually recover from the recent recession, the employment outlook continues to be bleak, at least for the next 3 years.

Total housing starts in Ontario in 1992 were 55,772, and are projected by Canada Mortgage and Housing Corporation to increase to:

* 58,200 in 1993
* 67,200 in 1994

This compares with an average annual number of housing starts of almost 100,000 over the 1987-1989 period.

The Ministry of Finance expects the GDP to improve significantly this year and in 1993, and to be driven largely by increased exports. However, the forecast for the construction industry and for overall aggregate demand:

* remains uncertain and may be overly optimistic if the demand for new construction does not materialize
* may be realized if public work programs announced by the federal and provincial governments are implemented to create more jobs and which may result in increased local demand for aggregate

The GTA has less than 2 percent of the land area of Ontario (Figure 2), while containing more than 50 percent of its population. The population of the GTA has also been forecast to increase by approximately 20 percent to 6 million people by the year 2021 (IBI Group, 1990).

The increasing demand for aggregates in the GTA highlights a need to carefully plan for the continued supply of these materials.

2.3.2 Highway Planning and Needs

The planning, construction, and maintenance activities of the provincial highway system are interrelated. These activities are driven by:

* deficiencies which have been identified in the existing highway system
* priorities for new transportation facilities to meet future highway capacity for the people of Ontario

For the purpose of total highway management, the Ministry of Transportation has, since the early 1970s, maintained four categories for highway construction needs as follows:

i) Current needs
- addressed each fiscal year
- includes the rehabilitation, maintenance or upgrading of existing facilities (i.e. widening of Highway 401 from Scarborough to Pickering and from Milton to Cambridge)

ii) Needs 1-5 Years
- addressed by the Multi-Year Construction Program (MYCP)
- in addition to rehabilitation, maintenance and upgrading, the MYCP also includes the construction of new facilities (i.e. Highway 407 from Highway 427 to Highway 400)
- planning studies have normally been completed where required
- soils, aggregates and pavement investigations as required

iii) Needs 6-10 Years
- referred to as 6-10 Year Program
- involves planning, design, soils and foundation investigations primarily for new facilities (i.e. Highway 407 from Highway 404 to Highway 48
- planning studies, as required have been completed or in progress

iv) Needs 10-20+ Years
- referred to as Long Range Transportation Planning
- involves long range planning for all modes including road, rail, air, water, transit, bicycle and pedestrian
- includes the preparation of Long Range Transportation Planning Study(s) followed by Route Planning Study(s) (i.e. Highway 407 from Highway 48 to Highway 35/115 and, the Pickering/Ajax/Whitby and Oshawa/Newcastle freeway links between Highways 407 and 401)

MTO carries out Transportation Planning and Route Planning Studies when required which allow for:

- problems to be identified
- existing and future highway capacity and deficiencies to be reviewed
- study databases to be assembled
- a long list of route alternatives to be developed
- screening the long list of alternatives to a short list of reasonable alternatives for additional study
- incorporating a series of Public Information Centres to present the various transportation alternatives under consideration, the preferred alternatives and finally, to outline the recommended scheme

Construction follows once highway needs have been identified through the ministry's

transportation planning process.

Appendix C, Part 3 includes an outline of MTO's highway-related mandate and strategic priorities. A geographic description of MTO's Central Region is provided in Appendix C, Part 4.

2.3.3 Highway Construction in the GTA

MTO's highway construction program:

* is achieved through the public tendering of contracts
* has most of the construction work carried out by hired contractors
* normally has MTO staff responsible for project administration and management
* has recently been assigning the responsibility to consultants for project administration, quality assurance and quantity measurements

For highway construction activities in the GTA, the ORM is one of the most important sources of aggregate. To place this importance in perspective from a "capital transportation expenditure" viewpoint, Appendix C, Part 5, is included to briefly review major planned roadwork in the GTA. For ease of presentation, the roadwork is categorized under GTA Highways and GTA Freeways.

The total planned GTA highway upgrading (excluding freeways) is 135 km, and an additional 56 km for widening. The total GTA freeway upgrading (excluding Hwy. 407) is 160 lane km, and an additional 233 lane km for widening.

Appendix C, Part 1, also includes a synopsis on the need, route planning studies and estimated costs for Highway 407 now under construction.

2.3.4 Wayside Pits and the Oak Ridges Moraine

Historically, MTO has used temporary wayside pits since the very early years of highway construction. Wayside pits in the Oak Ridges Moraine have supplied pit-run granular sub-base, crushed granular base and conventional hot mix pavement aggregates.

Table 6 shows a specific summary of wayside extraction in ORM during the period 1978 to 1991. An average of 250,000 tonnes were removed annually from ORM. This indicates a direct need for wayside pits on provincial highway and municipal road projects.

Facts of this type of extraction are:

* an average of 250,000 tonnes were removed annually from ORM
* 48 wayside pits have supplied approximately 3.5 million tonnes of aggregates from the GTA portion of the Oak Ridges Moraine between 1978 and 1991

Table 6

Summary of Wayside Production in the Oak Ridges Moraine (GTA), 1978 to 1991

Municipality	Municipal Waysides		MTO Waysides	
	# Permits	Tonnage	# Permits	Tonnage
Aurora	0	0	4	536,465
Caledon	1	13,650	0	0
East Gwillimbury	2	19,050	0	0
Newcastle*	0	0	3	395,000
Pickering	1	unknown	1	45,350
Richmond Hill	0	0	1	272,100
Scugog	15	430,900	2	110,000
Uxbridge	7	214,850	1	317,450
Whitby	1	35,000	0	0
Whitchurch/ Stouffville	5	464,750	4	600,125
TOTALS	32	1,178,200	16	2,276,490
Total Municipal and MTO Permits			48	
Total Wayside Tonnage			3,454,690	

Source: Ministry of Natural Resources

* Now known as Clarington

* 32 of these 48 wayside pits provided approximately 1.2 million tonnes (averaging 37,000 tonnes/pit) of aggregate for municipal roadwork
* the remaining 16 were MTO wayside pits that provided about 2.3 million tonnes (average of 143,000 tonnes/pit) of aggregate for provincial highway projects.

This data indicates a direct need for wayside pits on provincial highway and municipal road projects.

2.3.5 Comparison of Waysides to Commercial Sources

Wayside pits and quarries are important sources of aggregates for the MTO and municipalities because:

* in Ontario, approximately 60 percent of aggregates used by contractors for MTO contracts originate from non-commercial sources
* the remaining 40 percent is provided by commercial sources
* in southern Ontario, non-commercial sources supply aggregate mainly for lower quality granular base, sub-base and earth borrow uses
* commercial sources mainly supply products consumed in the higher specification uses such as Portland cement concrete and hot mix asphalt paving
* in northern Ontario, non-commercial sources supply almost all highway construction and maintenance aggregates
* in MTO Central Region, about 34 percent of the Ministry's aggregate needs originate from non-commercial sources

2.3.6 Future Provincial and Municipal Aggregate Need in the MTO Central Region

Based on past history and to fulfil the highway construction and maintenance program needs, it is estimated that MTO Central Region will continue to require approximately:

* 2 million tonnes of aggregates annually
* 10 million tonnes over the 1994-98 period (Table 7)

It has been found in the past that municipalities in Ontario on average use approximately six times as much aggregate as MTO and this translates to approximately 12 million tonnes of aggregates annually for municipalities in MTO's Central Region.

This annual production translates into a projected requirement (Table 7) in MTO's Central Region of:

* 60 million tonnes over the 1994-98 five-year period to fulfil the construction requirements of the local municipalities
* a combined total of approximately 70 million tonnes over the next five years to meet both the municipal and MTO requirements.

Table 7

Forecast MTO and Municipal Aggregate Requirements in MTO Central Region, 1994 to 1998

Material Type	MTO Requirements		Municipal Requirements		MTO/Municipal Requirements	
	Tonnes millions	% of Total	Tonnes millions	% of Total	Tonnes millions	% of Total
Granular Sub-Base (sandy material)	0.1	51	34.0	57	39.1	56
Granular Base (crushed gravel or bedrock)	3.5	35	20.0	33	23.5	34
Hot Mix Asphalt (crushed gravel or bedrock)	1.0	10	5.0	8	6.0	8
Concrete (crushed gravel or bedrock)	0.4	4	1.0	2	1.4	2
TOTAL	10.0[1]	100	60.0[2]	100	70.0[3]	100

The most likely sources to supply these requirements are:

1. 7 million tonnes from licensed pits and quarries; 3 million tonnes from wayside pits
2. 50 million tonnes from licensed pits and quarries; 10 million tonnes from wayside pits
3. 57 million tonnes from licensed pits and quarries; 13 million tonnes from wayside pits

The estimated area of land affected by this projected requirement for 70 million tonnes of aggregates would amount to a land disturbance covering approximately 233 hectares (or 576 acres), assuming an average extraction depth of 15 metres (50 feet).

The MTO has made a commitment to continue with an expanding highway construction program. It is expected that further aggregate requirements from pits under wayside permit will be required at the same rate as during the last few years. During the five-year period 1987 to 1991, MTO Central Region consumed approximately 0.6 million tonnes of wayside

aggregates per year. It is estimated that the demand will continue at this rate at least until 1998 and perhaps beyond.

As the acceleration of the transportation capital expenditure program in MTO Central Region continues, it is reasonable to anticipate that:

* the need for wayside pits in ORM will increase for provincial highway construction and maintenance
* there will also be a continuing need for wayside pits for maintaining and improving the local and regional road systems

Wayside pits will continue to be a necessity because:

* financial savings are realized
* shorter haul distances often result
* some commercial producers are not interested in supplying high quality aggregates for low quality uses at low prices

The use of wayside pits provides benefits to MTO and MNR's resource management objectives by:

* enhancing opportunities to use abandoned and unrehabilitated pit sites
* enhancing opportunities to use lower quality deposits thereby ensuring conservation of higher quality deposits
* reducing haulage distances on regular commercial haul routes
* enhancing competitive bidding and increased potential for cost savings on MTO contracts
* reducing aggregate prices and increasing savings to the taxpayer

2.4 SUMMARY

1) Aggregate is a "non-renewable" resource that has few other substitutes available in the same quality and none in the same quantity.

2) Aggregate extraction has co-existed with other land uses on the Oak Ridges Moraine for over 100 years while supplying essential aggregate products for the GTA and local growth (economic development).

3) Over 50 percent of aggregate demand is generated by the public need for transportation facilities.

4) Over 70 percent of ORM aggregate production is used in high quality applications related to ready-mixed concrete, asphalt and granular road bases.

5) The demand for aggregate products is based on the need for the resource. This need in the GTA has averaged 64 million tonnes from 1986-90.

6) Almost 50 percent of the GTA production of sand and gravel comes from within the ORM(GTA). A significant increase in the demand for ORM aggregate resources, within the GTA, is forecast over the next 20 years. It is expected that the need for aggregates in the GTA will approach 80 million tonnes/year by the turn of the century and 87 millions tonnes/year by the year 2010.

7) ORM aggregate resources are essential to the provincial, regional and municipal public infrastructure, construction, and maintenance programs within and adjacent to the GTA.

8) The overall share of aggregate production from the GTA and ORM(GTA) has decreased compared to other parts of the study area increasing the depletion of resources in areas outside the GTA.

9) Use of wayside pits by MTO and municipalities enhances resource management objectives and results in significant cost savings to the province and taxpayers.

3.0 SUPPLY

3.1 GENERAL GEOLOGY AND HYDROGEOLOGY OF THE OAK RIDGES MORAINE

The location of the Oak Ridges Moraine and the GTA portion of the moraine are shown on Figure 1, Chapter 1. The distribution of the aggregate resources found within the moraine can be directly linked to the geological development of the moraine.

The geology of the Oak Ridges Moraine has been described by Chapman and Putnam (1951, revised 1984) and Gravenor (1957). The moraine was formed at the confluence of two glacial ice lobes. Ice of the:

* Lake Simcoe Ice Lobe moved in from the north-northeast
* Lake Ontario Ice Lobe advanced out of Lake Ontario.

The topography and stratigraphy of the ORM resulted from deposition of glacial till and glaciofluvial outwash/ice contact sediments associated with the two ice lobes. Deposits of glacial till (unsorted clay to boulder size material) were:

* eroded from the bedrock surface by the movement of the glaciers
* subsequently deposited at the base and in front of the ice lobes
* affected by oscillation in the frontal positions of the ice lobes (i.e. fronts that moved forward and retreated at varying times).

Glaciofluvial and glaciolacustrine materials:

* were eroded from glacial till by meltwaters from the glacier and carried along glaciofluvial channels within, atop, or at the base of the glacier
* consisting of coarser sediments of sand and gravel were deposited within the glaciofluvial channels and where these streams entered the lakes
* consisting of finer materials were transported to interlobate glacial lakes that formed between the two lobes and deposited as fine sands, silts and clays.

The interstratification of glacial till with the outwash sediments indicate that the glaciers advanced and retreated at various times into the interlobate area to deposit these materials in their present location.

Deposits exposed at the surface are reasonably well mapped. The internal composition of the moraine is not well known having been established by studying the records (logs) of water wells drilled into the moraine. Ongoing drilling programs by the Ontario Geological Survey (Barnett 1992, 1993) and the Geological Survey of Canada will refine this knowledge.

Much of the earlier data had been recorded by non-geologists and the identification of sand and gravel materials has been reasonably accurate. However, the distinctions between clay (a glaciolacustrine deposit) and glacial till is not as accurate and glacial till has been misinterpreted as clay, stony clay or clay mixed with gravel.

Water well logs can be used to demonstrate the complexity of deposition within the moraine. Water well records were compiled for three cross-sections of the moraine (Figure 5). These schematic sections, shown in Figures 6a, 6b and 6c (modified after Deike & Katona, 1972), show that the moraine is not composed of all sand and gravel but also contain large amounts of clay and till of varying composition.

Aggregate resources utilized by the construction industry are associated mostly with the glaciofluvial deposits. The occurrence and distribution of these materials is therefore controlled by the geology and the complex depositional history of the moraine. It is therefore not unexpected that problems may be expected in locating sand and gravel deposits within the moraine.

The complex geological stratigraphy of the moraine has also been a major influence on the hydrogeology of the moraine. The hydrogeology and hydrology of the moraine is the subject of other ongoing studies including:

* ORMTWC: Background Study No.3 - Hydrogeological Evaluation
* a study by the Groundwater Research Group at the University of Toronto (study commenced in late 1991)
* a combined study by the Ontario Geological Survey and the Geological Survey of Canada (NATMAP) that was commenced in April 1993.

These studies have the objective of providing a scientific basis for the management of groundwater resources in the Oak Ridges Moraine.

One of the preliminary conclusions from this recent work is that the ORM is not as wide as once believed and there is less sand and gravel (Barnett 1993).

The ORM is described as playing a critical role in maintaining the quality and quantity of water resources for the GTA. It is anticipated that the above mentioned hydrogeological studies will examine any possible effects of aggregate extraction on surface and groundwater quality including:

* changes in surface and groundwater temperature
* changes in water loss due to evaporation or transpiration
* potential water table changes and drawdown effects
* changes in infiltration and recharge capacity
* potential for contamination and attenuation aspects of contamination if any
* remnant post extraction effects after pit rehabilitation, including evapotranspiration, surface water management, and wetland creation.

Figure 5

Location of Stratigraphic Cross Sections of the Oak Ridges Moraine

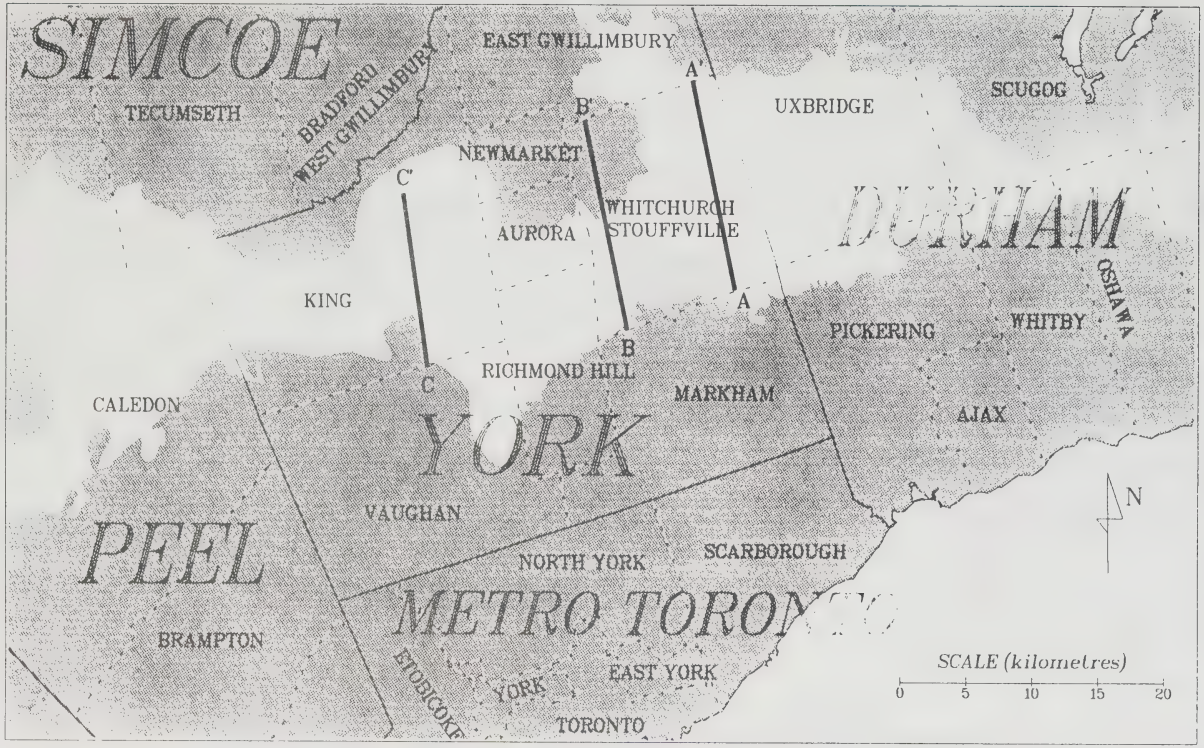


Figure 6a

Cross-Section A - A' Through Oak Ridges Moraine, Town of Whitchurch-Stouffville
Con. VII, Lots 1-50, Stratigraphy Plotted From Water Well Logs

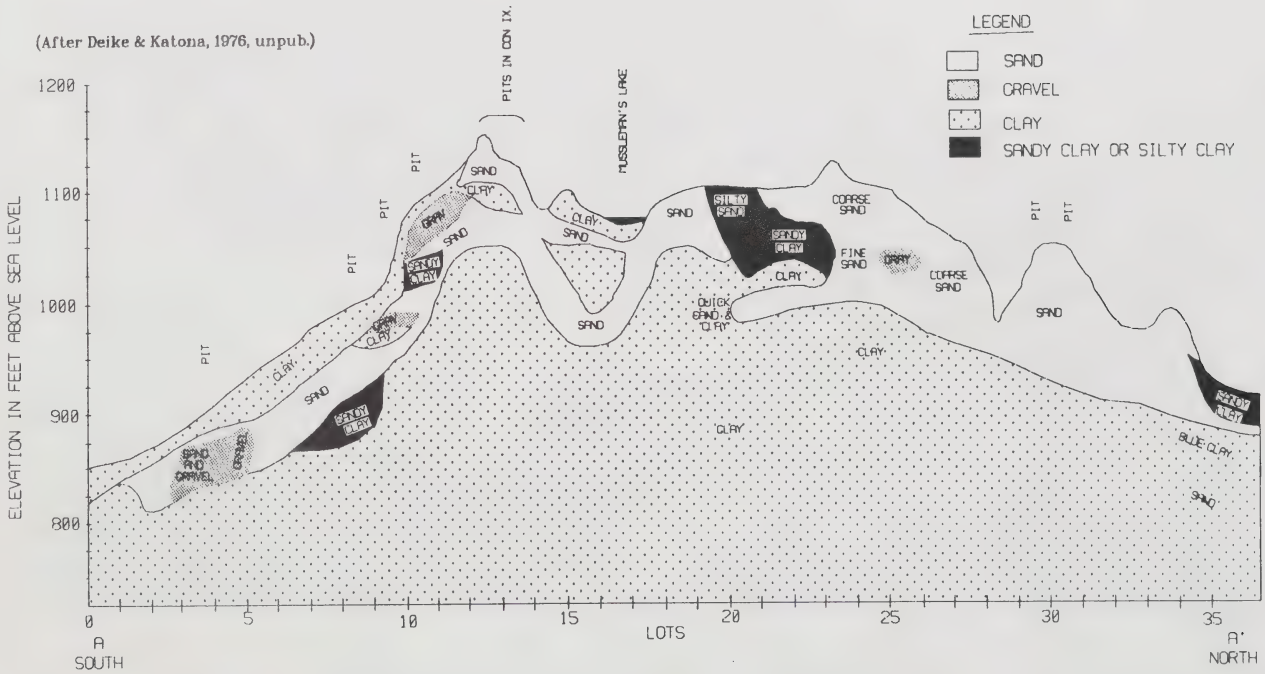


Figure 6b

Cross-Section B - B' Through Oak Ridges Moraine, Town of Whitchurch-Stouffville
Con. IV, Lots 1-35, Stratigraphy Plotted From Water Well Logs

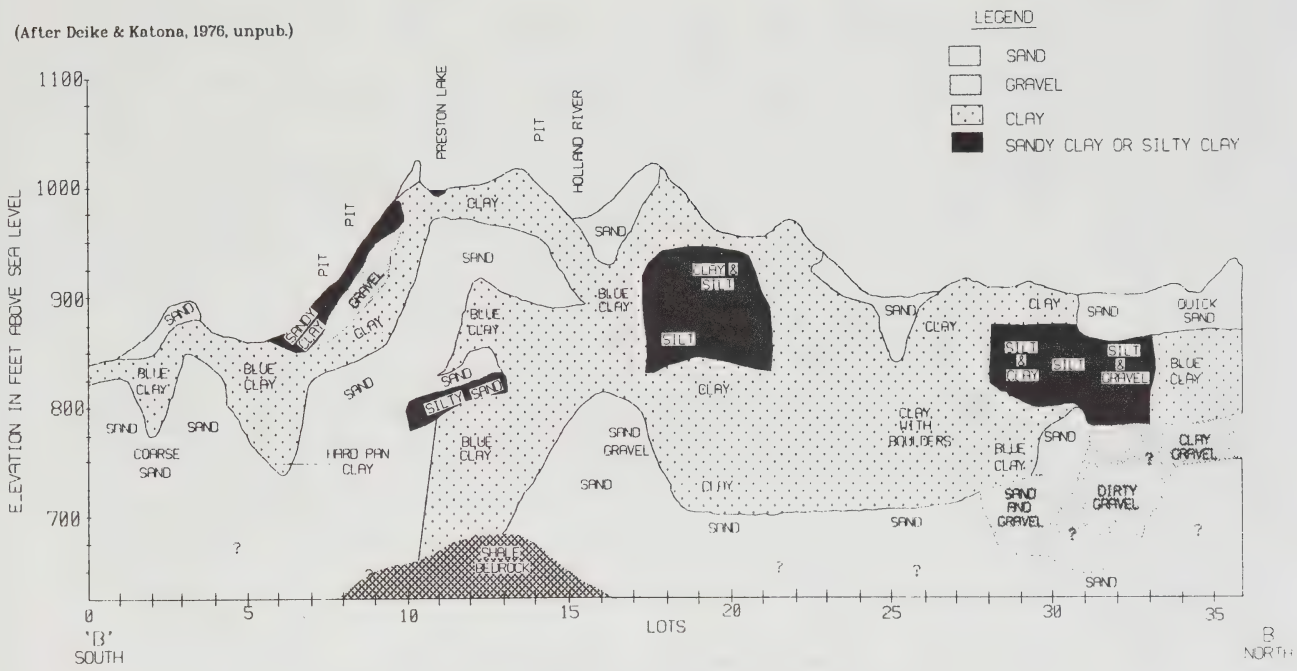
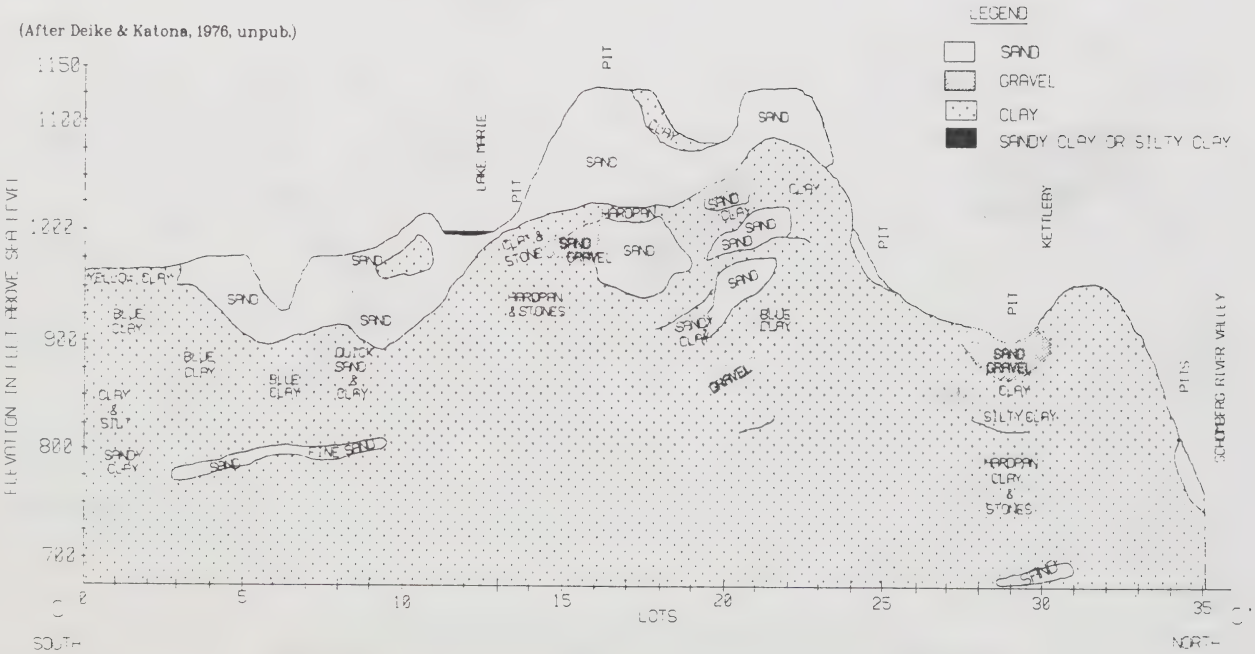


Figure 6c

Cross-Section C - C' Through Oak Ridges Moraine, Township of King
Stratigraphy Plotted From Water Well Logs



These concerns should be addressed, whether extraction is from above or below the groundwater table, at the time of licensing under the Aggregate Resources Act.

The aggregate industry in Ontario has a long history of below water table extraction. The experience with underwater extraction is:

* there is no cause for alarm from underwater extraction
* underwater extraction can enhance groundwater recharge rather than deplete recharge
* the creation of new lakes and water bodies has often added a form of biodiversity to the landscape
* extraction has provided a variety of after uses for both human and non-human use

Some interesting facts about aggregate extraction on the ORM include:

* all extraction is confined to unconsolidated materials, mostly in sand and gravel deposits
* occurs only at certain locations on the moraine
* typically occurs at the surface and above the water table with most operations extracting aggregates from above the water table
* 27 of the 95 operations do have approval to extract below the water table
* only 426 hectares or 10 percent of the total licensed area (4290 hectares) on the ORM(GTA) is approved for underwater extraction
* no aggregate extraction site is dewatering (i.e. pumping water to lower the water table)
* extraction has been subject to very few complaints to the Ministry of Environment and Energy (MOEE) concerning allegations of water interference caused by aggregate operations in the ORM.

There are a number of examples of successful underwater extraction activities in the province, including Professor's Lake and Snyder Flats, that are discussed in Appendix J.

3.2 REGIONAL DISTRIBUTION OF AGGREGATE RESOURCES

In order to determine the importance of the GTA portion of the Oak Ridges Moraine as a source of sand and gravel, a review of the potential resource areas occurring both within and outside of the moraine is required. An overview of the other potential resource areas will be provided and this, together with the data on resource distribution in the GTA (Section 3.3) and in the ORM(GTA) (Section 3.4), provides the basis for a discussion of resource availability (Section 3.9). Some of the resource data comes from ARIP mapping and some from information on file with MNR. The data has been compiled by MNR using a Geographic Information System (GIS), for presentation in this report.

3.2.1 Aggregate Resource Mapping

The main tool for the identification of aggregate resources in Ontario has been aggregate resource mapping carried out by the Ontario Geological Survey, formerly of MNR, but now with the Ministry of Northern Development and Mines, since the early 1970s.

The results of aggregate resource mapping are published in a series of reports called "Aggregate Resources Inventory Papers" (ARIPs). These reports typically include 3 maps:

ARIP Map 1: Distribution of Sand and Gravel Deposits
ARIP Map 2: Selected Sand and Gravel Resource Areas
ARIP Map 3: Bedrock Resources

The contents of each of these maps is more fully described in Appendix D, Part 1. Not all of the resource areas defined in ARIPs are available for aggregate development. When considering alternate supply sources, it must be verified by the prospective operator that the alternative potential resource areas are:

* comparable in quality (i.e. acceptable for use in a variety of concrete or other construction uses) and available in sufficient quantities
* accessible from existing haul routes and within an economic haul distance
* satisfactory for a broad range of construction uses
* without significant environmental or land use constraints
* only limited by constraints that are not as important in the local area as are constraints (e.g. environmental features) within the Oak Ridges Moraine
* available to be purchased or leased and zoned for extraction purposes.

These limitations are discussed as constraints on resource availability in Section 3.5.

3.2.2 Digital Map Coverage

MNR has digitally compiled a portion of the ARIP information for southern Ontario using a GIS mapping system (MapInfo). The areas of potential resources shown on the figure and tables also include resource areas that may be licensed. ARIPs exclude licensed properties. The areas of potential resources shown in the following tables are derived from calculations based on these digital files.

Over eighty (80) percent of the Aggregates Study Area (as shown in colour on Figure 1) has digital aggregate resource mapping available. The remainder (in white) either does not have ARIP mapping (aggregate resource mapping) available or digital compilation has not been completed. Appendix D, Part 2, provides more detail on these areas. The analysis and conclusions on the regional distribution of potential resources is not considered to be affected significantly by the exclusion of these areas.

3.2.3 Regional Distribution of Potential Sand and Gravel Resource Areas

The location of the potential sand and gravel resource areas are shown on Figure 7 and summarized in Table 8. Within the Aggregates Study Area, the GTA contains proportionally the majority of the sand and gravel resources. The GTA contains:

* almost 30 percent (26,310 ha) of the potential sand and gravel resources of primary significance
* almost 40 percent (53,755 ha) of the potential sand and gravel resources of secondary significance.

Figure 7 also shows the location of "distant" resources outside the Aggregates Study Area. These areas should not be considered as new supply source areas for the GTA because they are too distant and generally lack an adequate transportation link to the GTA.

Table 8

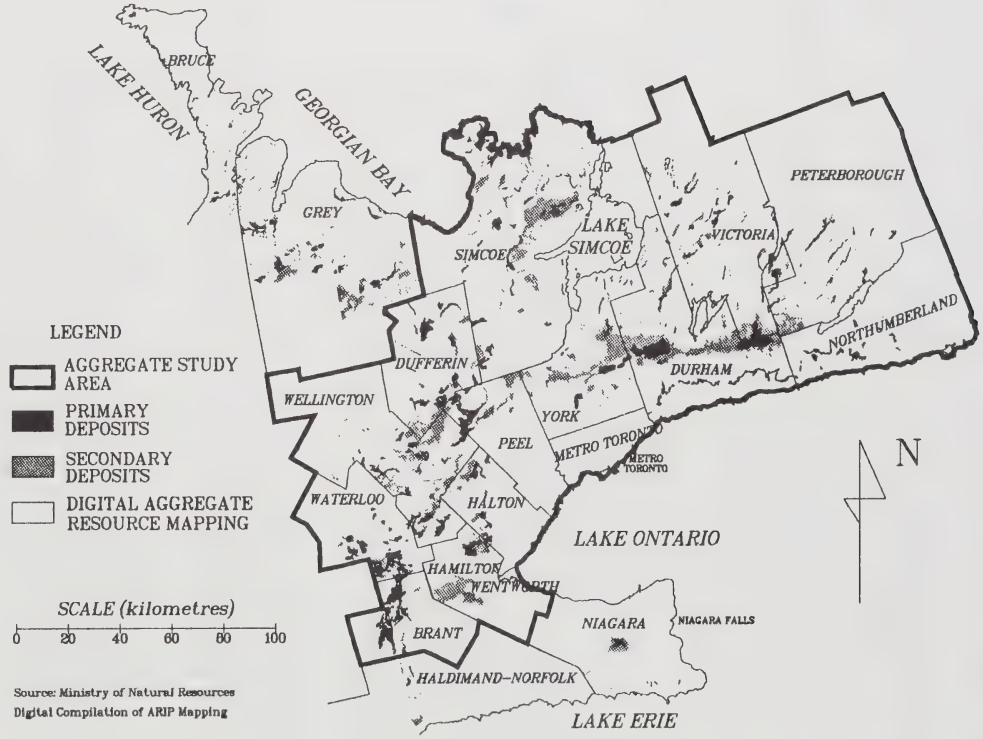
Regional Distribution of Potential Sand and Gravel Resource Areas

	Primary	Secondary
Region / County	(hectares)	(hectares)
Northumberland*	443	13,440
Victoria	8,649	11,010
Simcoe*	18,599	24,407
Brant	9,921	1,077
Wellington	9,658	14,214
Hamilton-Wentworth	2,317	11,289
Waterloo	9,282	2,313
Peterborough	3,363	6,140
Greater Toronto Area (GTA)	26,310	53,755
Total	**88,542**	**137,645**

Note: Overlapping licensed areas are included in the calculation of the areas.
* ARIP mapping data for Northumberland is incomplete, and Simcoe includes preliminary data for Rama and Mara Townships (OGS pers. comm.).

Figure 7

Regional Distribution of Potential Sand and Gravel Resource Areas



3.2.4 Regional Distribution of Potential Bedrock Resource Areas

The location of the potential bedrock resource areas are shown on Figure 8 and include selected bedrock resource areas with less than eight metres of overburden as identified on ARIP bedrock maps. Table 9 summarizes the estimated areas of potential bedrock resources for the Aggregates Study Area categorized as limestone, sandstone or shale. The GTA contains:

* 14 percent (23,997 ha) of the potential limestone
* 100 percent (1,603 ha) of the potential sandstone
* 96 percent (10,732 ha) of the potential shale resource areas within the Aggregates Study Area.

Figure 8 also shows bedrock resources that are more distant and outside the Aggregates Study Area, but these can not be considered as potential supply sources due to the same limitations as discussed for the distant sand and gravel resources in Section 3.2.2.

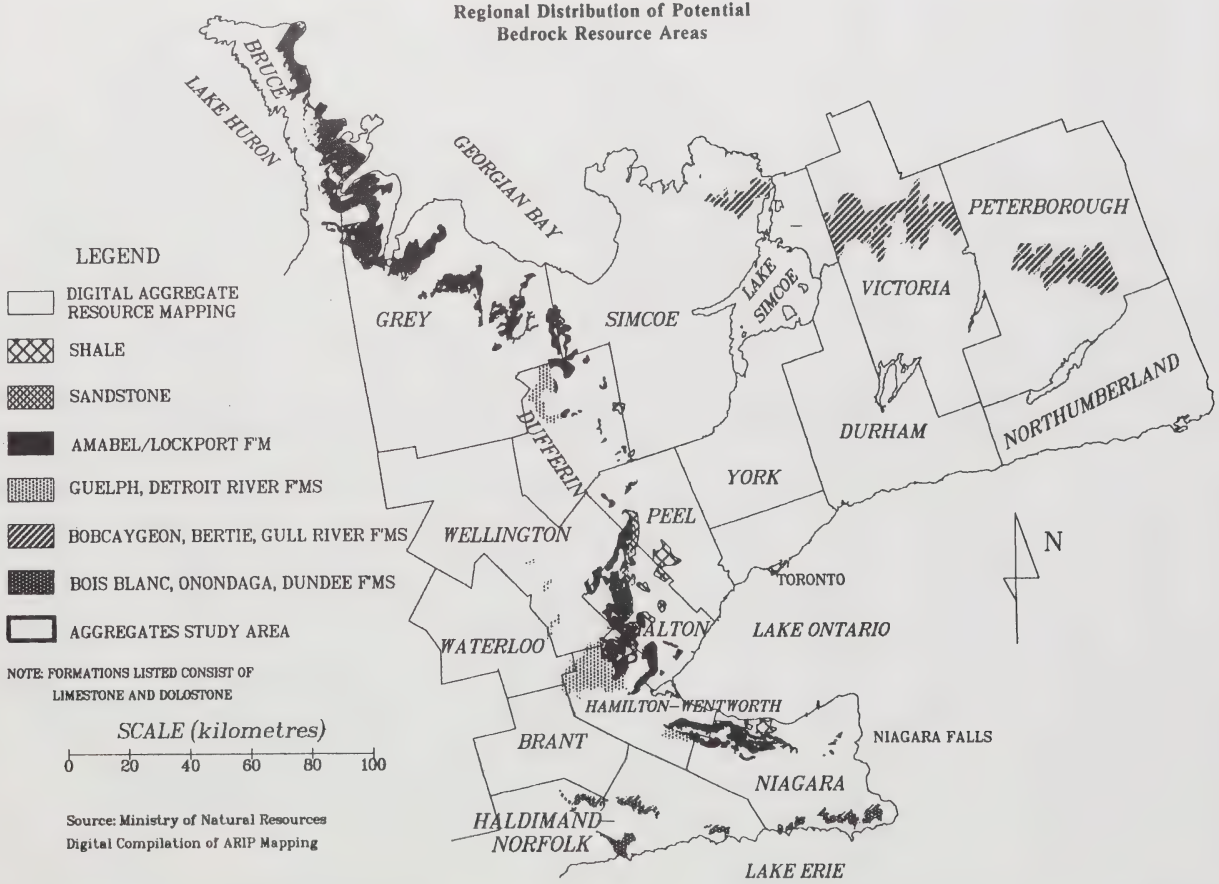
Table 9
Regional Distribution of Potential Bedrock Resource Areas

	Limestone	**Sandstone**	**Shale**
Region	(hectares)	(hectares)	(hectares)
Northumberland*	1,460	-	-
Victoria	48,008	-	-
Simcoe *	33,460	-	479
Brant	336	-	-
Wellington	2,714	-	-
Hamilton-Wentworth	33,291	-	-
Waterloo	1,130	-	-
Peterborough	31,366	-	-
Greater Toronto Area (GTA)	23,997	1,603	10,732
Total	**175,762**	**1,603**	**11,211**

Note: Overlapping licensed areas are included in the calculation of the areas.
*ARIP mapping data for Northumberland is incomplete and Simcoe includes preliminary data for Rama and Mara Townships (OGS pers. comm.).

Figure 8

Regional Distribution of Potential Bedrock Resource Areas



3.3 POTENTIAL AGGREGATE RESOURCES OF THE GREATER TORONTO AREA

The GTA is the largest consumer of aggregates in Ontario but produces only about 60 percent of its aggregate requirements. It imports in excess of 40 percent of its aggregate requirements mainly from the surrounding areas, although smaller amounts of some speciality products (e.g. dense friction coarse aggregates for skid resistance) come from more distant locations in Ontario.

The potential aggregate resource areas of the GTA are not evenly distributed across the GTA. This section discusses the potential sand and gravel and bedrock resource areas, in relation to their distribution in the regional municipalities of Halton, Peel, York, Durham and Metropolitan Toronto that constitute the GTA.

3.3.1 Potential Sand and Gravel Resources of the Greater Toronto Area

The distribution of primary and secondary deposits of sand and gravel within the GTA and including the ORM(GTA) are shown on Figure 9. Table 10 provides a listing of "Potential Sand and Gravel Resource Areas" of primary and secondary significance broken down by regional municipality within the GTA.

Table 10

Potential Sand and Gravel Resource Areas, Greater Toronto Area

	Primary	Secondary
Region	(hectares)	(hectares)
Durham	13,198	26,296
York	4,721	17,624
Peel	5,354	6,016
Halton	3,037	3,819
Metropolitan Toronto	-	-
Total	26,310	53,755

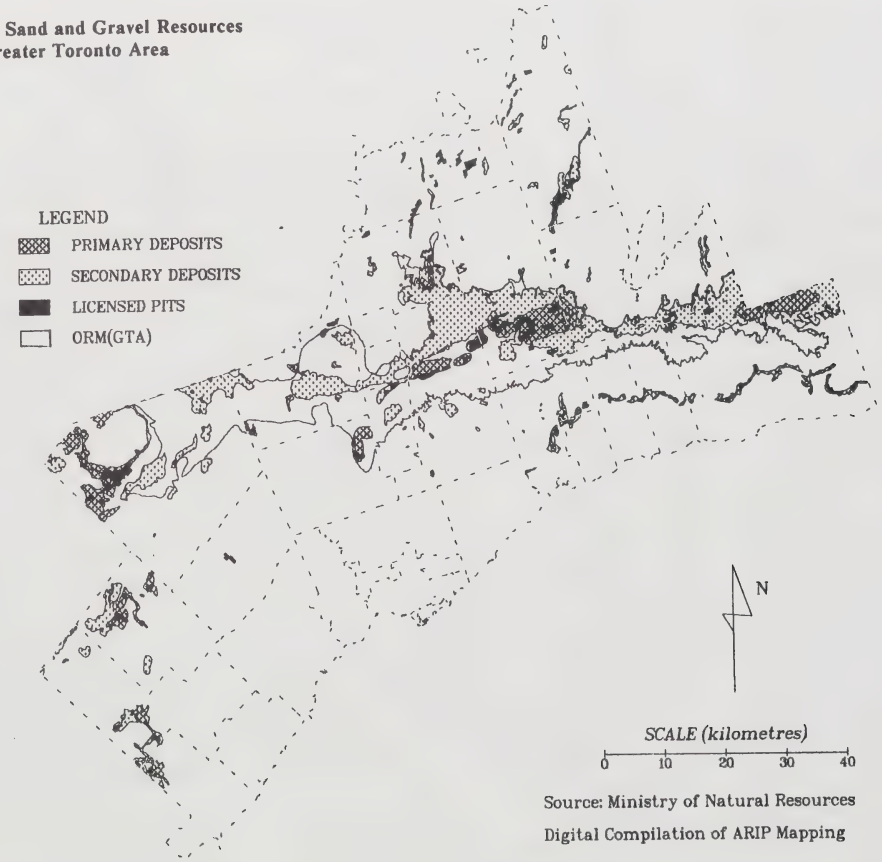
Note: Overlapping licensed areas are included in the calculation of the areas.

A comparison of potential sand and gravel resource areas within the GTA indicates that:

* 50 percent (13,198 ha) of the potential primary and 49 percent (26,296 ha) of potential secondary sand and gravel resource areas occur within Durham Region

Figure 9

Potential Sand and Gravel Resources of the Greater Toronto Area



Source: Ministry of Natural Resources
Digital Compilation of ARIP Mapping

* York Region has only 18 percent (4,721 ha) of potential primary sand and gravel resource areas but has 33 percent (17,624 ha) of the potential secondary deposits within the GTA
* Peel and Halton regions have comparatively less potential resource areas
* Metropolitan Toronto contains no potential sand and gravel resource areas.

3.3.2 Potential Bedrock Resources of the Greater Toronto Area

Potential bedrock resources (i.e. buried by less than 8 metres of overburden) within the GTA are confined to the regional municipalities of Halton and Peel (Figure 10) in the western GTA, as summarized on Table 11. Halton Region contains the bulk of these resources in the GTA including:

* 89 percent (21,342 ha) of the potential limestone resource areas
* 73 percent (1,164 ha) of potential sandstone resources areas
* 47 percent (5,217 ha) of the potential shale resources

Table 11

Potential Bedrock Resource Areas
Greater Toronto Area

	Limestone	Sandstone	Shale
Region	(hectares)	(hectares)	(hectares)
Durham	-	-	-
York	-	-	-
Peel	2655	439	5515
Halton	21342	1164	5217
Metropolitan Toronto	-	-	-
Total	23997	1603	10732

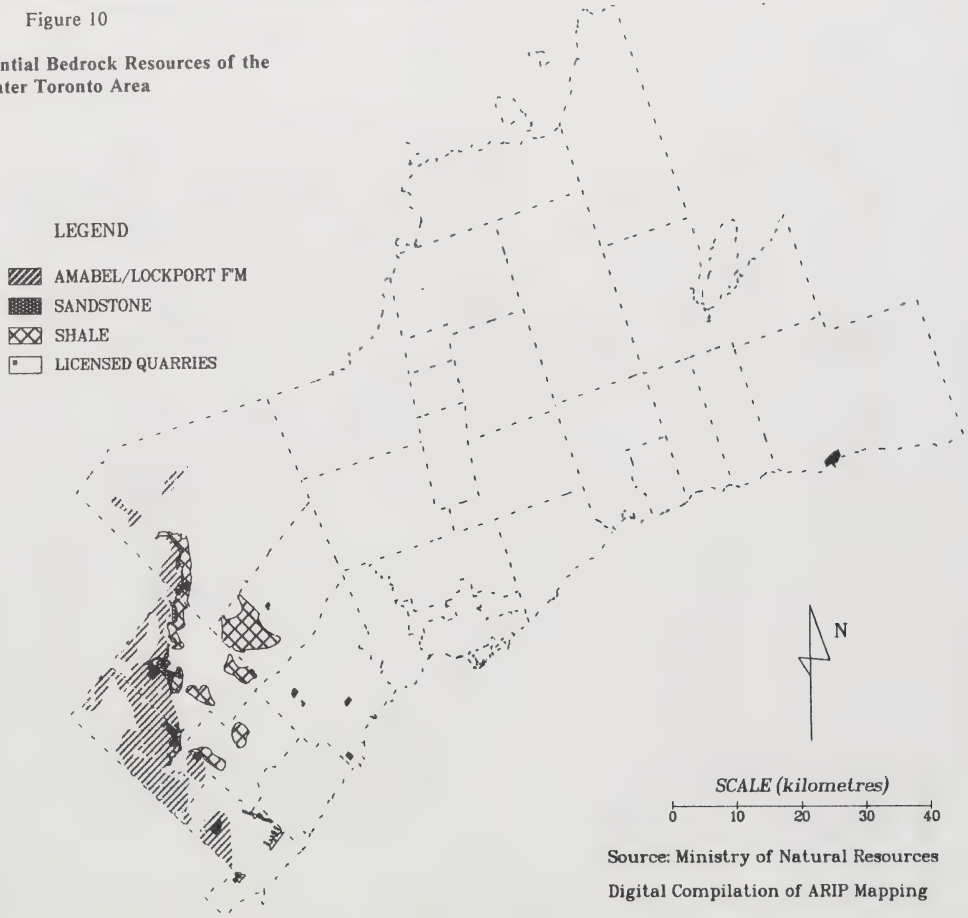
Note: Overlapping licensed areas are included in the calculation of the areas, with the exception of St. Mary's Cement Quarry in Durham.

These bedrock resources consist of:

* limestone and dolostone of the Amabel and Lockport formations that provide a full range of crushed stone, building stone and chemical stone products

Figure 10

Potential Bedrock Resources of the Greater Toronto Area



Source: Ministry of Natural Resources
Digital Compilation of ARIP Mapping

* shales of the Queenston Formation, which are a major source of material for use in the manufacture of clay brick, tile and sewer pipes
* sandstones of the Whirlpool Formation, a source of unique building and ornamental stone used, for example, in the Ontario Legislative Assembly building.

Crushed stone products are derived from limestone and dolostone. Their uses include:

* asphalt and concrete
* road base and sub-base
* open graded drainage layers.

These materials:

* are widely used in road construction throughout the GTA, particularly in the western portion of the GTA
* include resources of the Amabel and Lockport formations which meet the highest quality aggregate standards for applications such as concrete used for the CN Tower and for highway overpasses.

3.4 POTENTIAL RESOURCE AREAS OF THE OAK RIDGES MORAINE (GTA)

The ORM(GTA) does not contain any potential bedrock resources. The following discussion will highlight the distribution of sand and gravel deposits of primary and secondary significance which occur throughout the ORM and are the dominant supply sources.

3.4.1 Potential Sand and Gravel Deposits of Primary Significance

The distribution of sand and gravel deposits of primary significance are shown in Figure 11 and summarized on Table 12.

These deposits:

* generally occur within the core or central portion of the moraine
* include only 9.4 percent (13,099 hectares) of the portion of the moraine within the GTA
* include a majority of the existing licences.

Primary deposits within the ORM(GTA) are prominent within the municipalities of:

* Whitchurch-Stouffville (2,179 hectares)
* Uxbridge (5,305 hectares)
* Newcastle (renamed Clarington) (5063 hectares).

Primary deposits generally contain a significant portion (>35 percent) of gravel size materials.

3.4.2 Potential Sand and Gravel Deposits of Secondary Significance

Sand and gravel deposits of secondary significance (Figure 11) within the ORM(GTA) are also summarized on Table 12. In general, deposits of secondary significance:

- are prominent within each of the municipalities along the moraine
- cover approximately 31.7 percent (44,361 hectares) of the surface area of the moraine in the GTA
- generally contain sand as the predominant sediment type although gravel is usually present but in much less quantity
- include a number of licensed operations including those whose products are primarily sand-based or who are blending on-site sand with imported crushed stone to produce a variety of construction aggregates.

Secondary deposits in the ORM(GTA) are prominent within the municipalities of:

- Whitchurch-Stouffville (6,454 hectares)
- Uxbridge (8,643 hectares)
- Newcastle (Clarington) (6,830 hectares)
- Scugog (7,099 hectares)
- Caledon (6,017 hectares).

Table 12

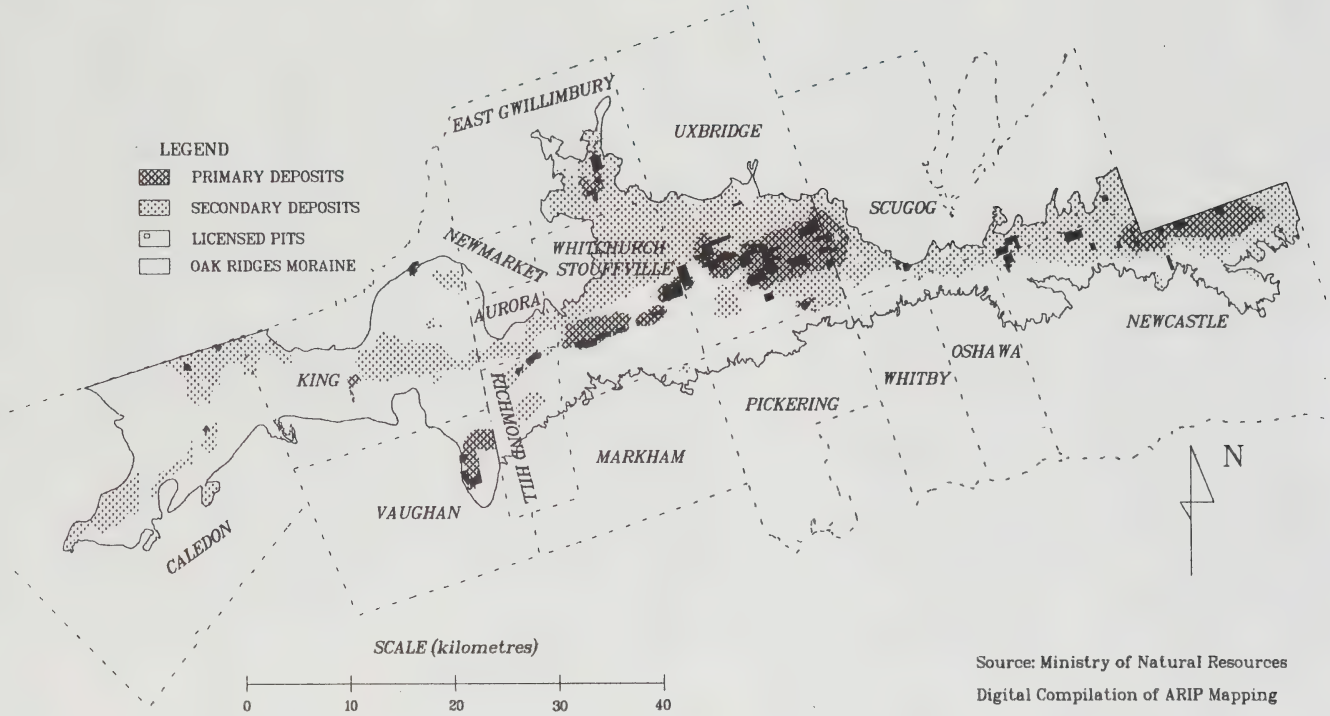
Potential Sand & Gravel Resource Areas
Oak Ridges Moraine - GTA Portion

	Primary	Secondary
Region	(hectares)	(hectares)
Durham	9,129	22,683
York	3,970	16,518
Peel	-	5159
Halton	-	-
Metropolitan Toronto	-	-
Total	13,099	44,360

Note: Overlapping licensed areas are included in the calculation of the areas.

Figure 11

Potential Sand and Gravel Resource Areas
Oak Ridges Moraine, GTA Portion



Source: Ministry of Natural Resources
Digital Compilation of ARIP Mapping

3.5 CONSTRAINTS ON POTENTIAL RESOURCE AREAS

Potential aggregate resource areas are not all available for licensing. Calculation of areas of potential resources has a limited value in any assessment of the province's capability to meet the demand for aggregates. The use of volumetric or tonnage calculations such as presented in ARIPs can be equally misleading. It is important to recognize that much of these potential resource areas will never be developed for many reasons including geological (not all resources become reserves), economic, environmental, social and land use constraints.

3.5.1 Transition of Resources to Reserves

The terminology used in determining what constitutes a resource versus a reserve has created confusion for many people. Not all potential resources will be available for aggregate development or licensing due to, for example, geological, locational, land use, environmental or social constraints. Even if a property is licensed, some of the licensed resource may be unavailable for extraction, or be of poor quality or insufficient quantity to warrant extraction.

A variety of terms are used such as:

* resource areas
* potential resource areas
* potentially available resource areas
* licensed resources
* licensed aggregate reserves.

The definitions of these terms are provided on the following pages. This terminology will provide an understanding of the description of the distribution of potential resources (i.e. areas of potential for seeking future supply sources) and will be the basis of the discussion about the depletion of current licensed reserves, the existing supply.

Resource Areas

* are broad areas identified through general geological mapping (i.e. Quaternary or bedrock mapping) and/or broad aggregate investigations by provincial surveys and private industry
* have no or very limited sampling and testing to verify presence of the resource
* typically provide no analysis of geological, environmental or land use constraints.

Potential Resource Areas

* have favourable geology for the discovery of aggregate deposits (i.e. likelihood of resource verified by the presence of existing pits or quarries)
* have been identified by ARIPs or other equivalent surveys and studies
* may include unlicensed resources with an unknown reserve potential

* typically would include ARIP sand and gravel deposits of primary and secondary significance (or select tertiary deposits where other deposits are lacking) and selected bedrock deposits (i.e. less than 8m of overburden).

Potentially Available Resource Areas

These areas include Potential Resource Areas that:

* do not have preemptive constraints that would preclude possible development
* have minimal land use or other resource management conflicts
* have minimal environmental constraints and any impacts or perceived impacts from potential extraction operations may be mitigated
* have no known regulatory constraints due to land use conflicts, social or environmental protection, or there are some constraints that may be overcome from an operational and economic perspective
* have been selected in the land use planning process as areas where extraction may be permitted
* may be acquired (purchased or leased) and that are economically feasible for extraction and can be marketed.

Licensed Resource Areas

* are areas licensed under the ARA and known to contain aggregate resources
* may include some areas with no aggregate resources (i.e. outside the deposit area)
* may have had some sampling and testing (e.g. some licensed properties have not been tested outside of the active pit or quarry area)
* includes resources that may be uneconomical to extract, process, or are unmarketable due to limitations in quality or quantity of materials present
* includes resources unacceptable from a geological (quality and quantity) perspective and reserves unavailable for extraction due to setback restrictions (i.e. regulatory setbacks from licensed boundaries and areas of environmental sensitivity within the licensed area).

Licensed Aggregate (Proven) Reserves

* occur within a legally existing operation such as the licensed portion of the pit that is approved for extraction, as indicated on the site plans issued under the Aggregate Resources Act
* have a proven quality and quantity normally demonstrated through a professional geological assessment of the property, including extensive sampling, testing, and development of quality control measures to maintain quality during production and processing
* can be economically extracted and processed to meet a variety of product requirements
* can be profitably marketed to supply a ready demand area within a reasonably economic haul distance.

3.5.2 General Constraints on the Resource

Development of any aggregate resource areas, whether it is a potential primary or secondary sand and gravel deposit or potential bedrock deposit, may be limited due to:

* geological constraints resulting from the inherent limitations of the data used to identify the potential resource areas including:
  - location of the resource
  - proximity to a market area
  - detailed information on the quality and quantity of the resource
* land use constraints and restrictions that may prevent development
* environmental limitations
* social limitations.

Assuming there is a demand for the materials, the available geological information, location, quality and quantity of the resource must be thoroughly analyzed to determine whether or not the resource has potential for being economically viable. The prospective aggregate operator would be expected to carry out additional resource mapping and detailed exploration including:

* detailed site specific geological investigations and sampling of the aggregate materials to verify the location, quality and quantity of the resource
* analyses of economic parameters to determine whether there is a sufficient demand for the type of materials and products generated by the operation
* an assessment of land use, environmental and societal concerns of the proposed extraction operation to ensure there are no potentially limiting factors that might prevent development.

This information is normally provided by studies required prior to consideration for licensing under the Aggregate Resources Act and should be carried out by a prospective operator (or his consultant) prior to decisions to purchase or license. These detailed studies were beyond the scope of most of the normal aggregate inventory work carried out by government agencies and were beyond the scope of this study. Government's role in aggregate inventories, as with most other mining commodities, is to provide the regional level of mapping to assist industry in selecting areas for follow up or detailed exploratory work.

3.5.3 Limitations of an Analysis of Available Potential Resources

It has not been possible, due to a lack of detailed site specific geological information (as described above) and the incompleteness of data on land use and environmental data in a study such as this, to determine what potential resource areas can be guaranteed for development. For example, in this report and in relation to the Aggregates Study Area, it has not been possible:

* to refine the geological information on resources beyond the detail of the information in the ARIP mapping
* to compile all relevant land use and environmental data for the Aggregates Study Area

* to establish societal concerns and setbacks from incompatible existing land uses.

An example of a limited constraint analysis is provided. This example shows how the estimated areas of potential resources are reduced by known constraints and how an approximation (subject to some further limitations) of potentially available resource areas may be derived. It is suggested that the results of this analysis may with some limitations be extrapolated to other parts of the Aggregates Study Area.

Limitations and constraints on the development of potential aggregate resource areas is fully described in Part 1, Appendix E.

3.5.4 Constraints on Potential Resources in Whitchurch-Stouffville and Manvers

The Constraint Analysis was conducted on two municipalities (Figure 12):

* the Town of Whitchurch-Stouffville which spans the ORM(GTA)
* the Township of Manvers, which also spans the ORM but outside and to the east of the GTA

The official plans and zoning by-laws covering the two municipalities provided the greatest detail on current land use patterns. The municipal land use data was supplemented with data from the mandated interests of the MNR or other ministries (e.g. location wetlands, Areas of Natural and Scientific Interest (ANSIs), prime agricultural areas). The methodology enabled the calculation of potential resource area loss to these various constraints.

Each of the two municipalities of Whitchurch-Stouffville and Manvers:

* contain large portions of the moraine
* contain large areas of potential sand and gravel resources of both primary and secondary significance
* have reasonably up-to-date municipal planning information.

The constraints used in the analysis have been subdivided into:

<u>Preemptive Land Uses</u>

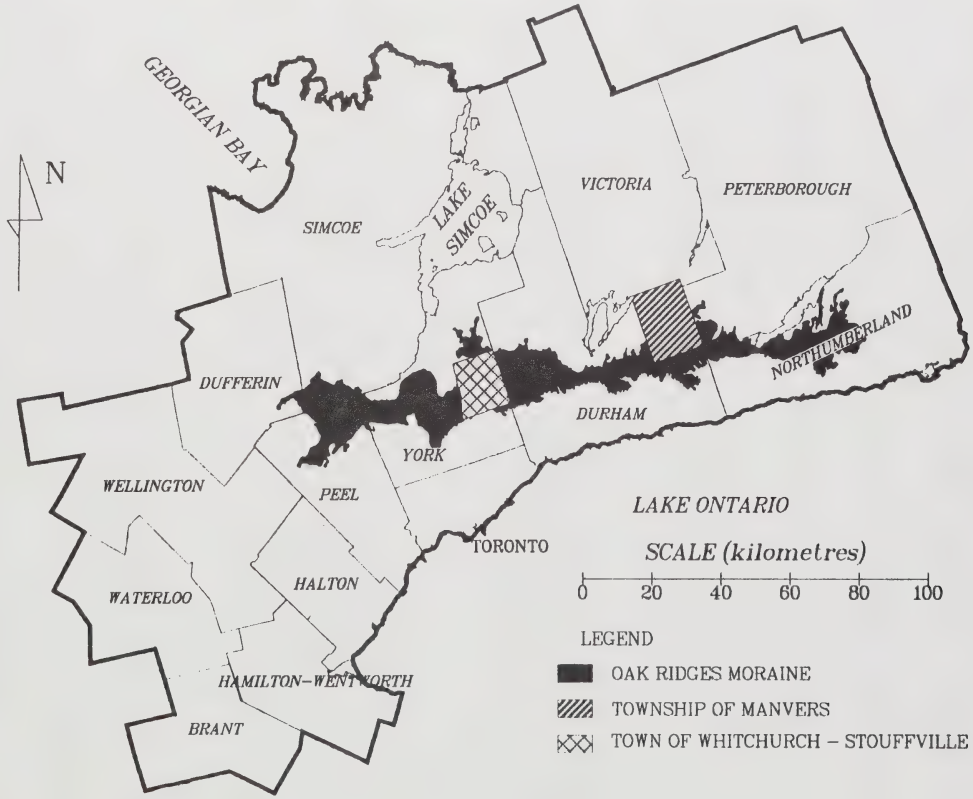
* Sterilize or preclude access to the resource (e.g existing residential, commercial or industrial development)

<u>Very Serious Constraints</u>

* Protection of other provincial interests (e.g. provincially significant wetlands, environmentally sensitive areas, agreement forests, Conservation Authority lands) put serious limitations or constraints on resource development

Figure 12

Locations of the Municipalities of Whitchurch-Stouffville and Manvers



Competing Land Uses

* In specific situations may prevent extraction (e.g. regionally significant wetlands, ANSIs, prime agricultural lands) but which, in general, may be developed if proper mitigative measures are emplaced prior to extraction to ensure protection of the environment or other natural resources.

The distribution of primary and secondary deposits within the Town of Whitchurch-Stouffville are shown in Figure 13. Figures 14, 15 and 16 show, respectively, the distribution of preemptive land uses, very serious constraints and competing land uses for this municipality. Table 13 summarizes the potential resource area loss to constraints. These constraints cumulatively affect:

* 97 percent of the potential primary resource areas
* 80 percent of the potential secondary resource areas in the Town of Whitchurch-Stouffville.

Similarly, the distribution of primary and secondary deposits within the Township of Manvers is shown in Figure 17. The distribution of preemptive land uses, the very serious constraints and competing land uses are shown in figures 18, 19 and 20, respectively. In the Township of Manvers, these constraints cumulatively affect:

* 36 percent of the potential primary resource areas
* 45 percent of the potential secondary resource areas

Table 13

Summary of Potential Resource Area Loss
Land Use Constraints: Whitchurch-Stouffville and Manvers

Municipality and Resource Type	Preemptive Land Uses	Very Serious Constraints	Competing Land Uses	Cumulative Loss Area
Whitchurch-Stouffville				
1. Primary	31.00%	7.83%	58.21%	97.04%
2. Secondary	20.93%	38.84%	20.73%	80.50%
Manvers				
1. Primary	20.21%	14.37%	1.49%	36.06%
2. Secondary	8.80%	29.74%	6.65%	45.19%

Note: A detailed breakdown of the individual constraint elements is provided for each municipality in Part 2, Appendix E (Tables E-1 and E-2).

Figure 13
Distribution of Sand and Gravel Deposits
Town of Whitchurch-Stouffville

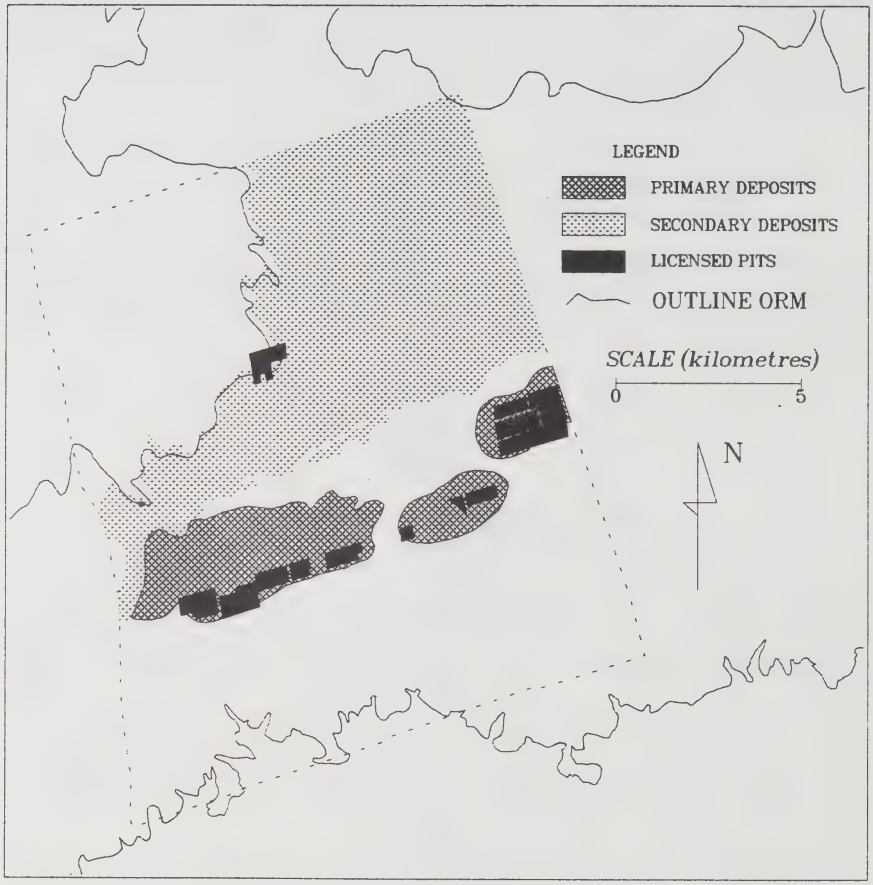


Figure 14
Aggregate Resource Development Constraints
Town of Whitchurch-Stouffville
Preemptive Land Uses

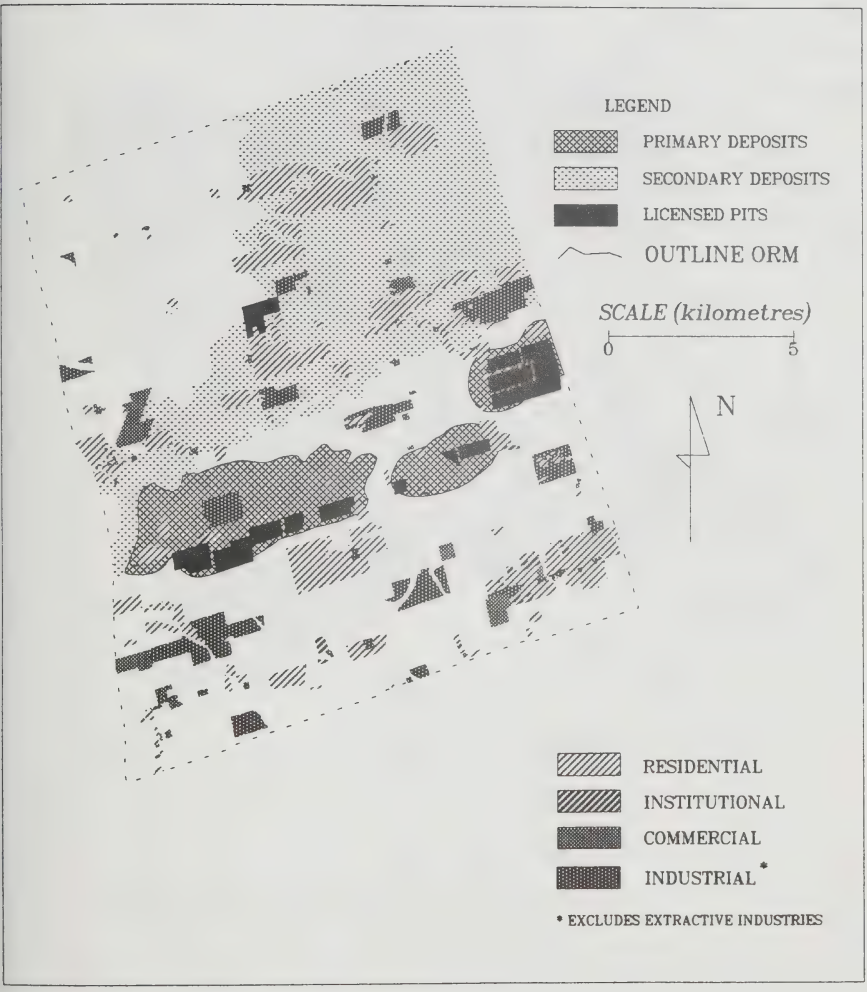


Figure 15
Aggregate Resource Development Constraints
Town of Whitchurch-Stouffville
Very Serious Constraints

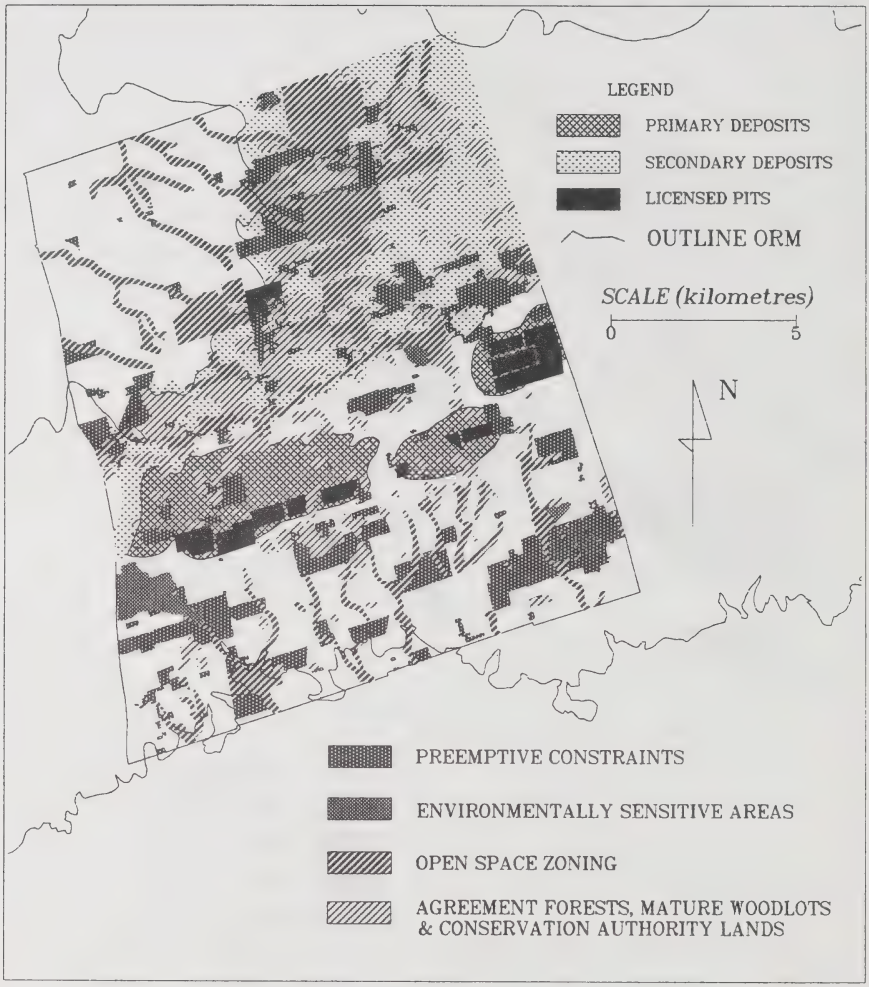


Figure 16
Aggregate Resource Development Constraints
Town of Whitchurch-Stouffville
Competing Land Uses

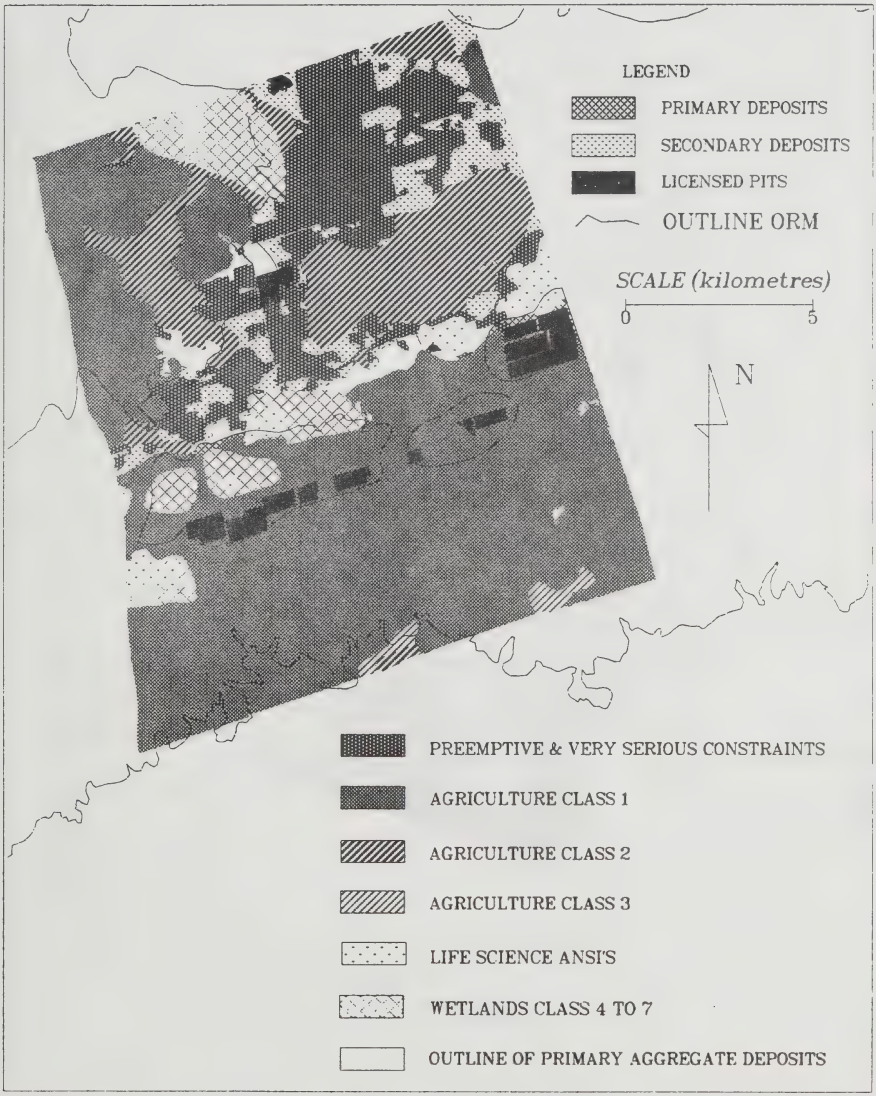


Figure 17
Distribution of Sand and Gravel Deposits
Township of Manvers

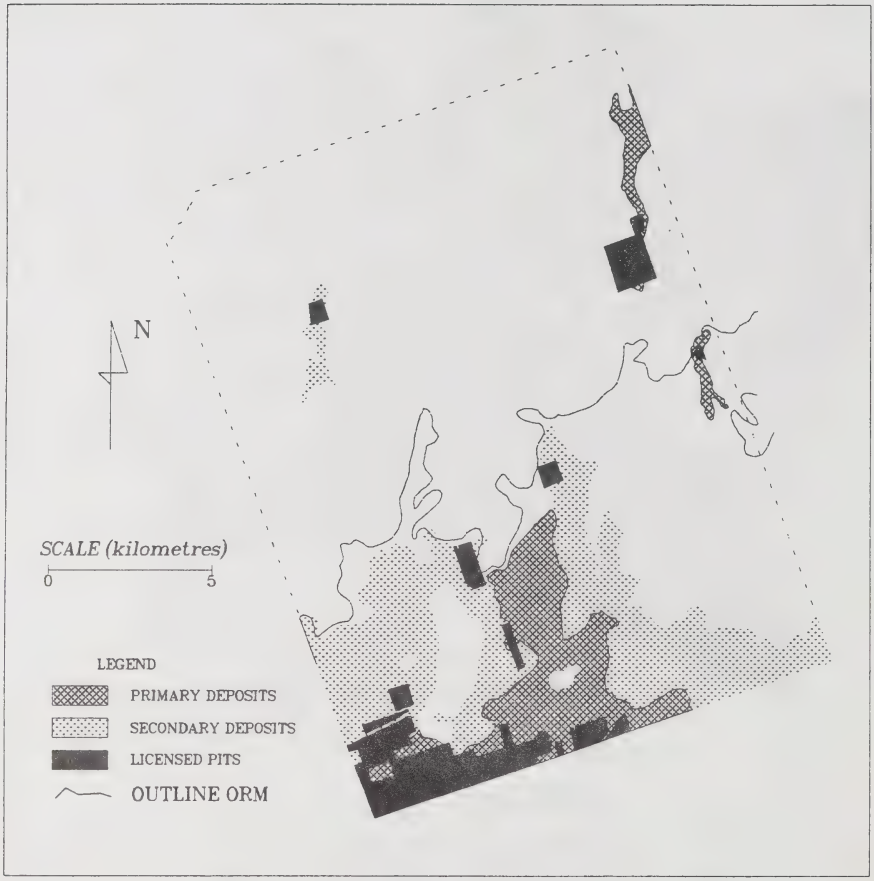


Figure 18
Aggregate Resource Development Constraints
Township of Manvers
Preemptive Land Uses

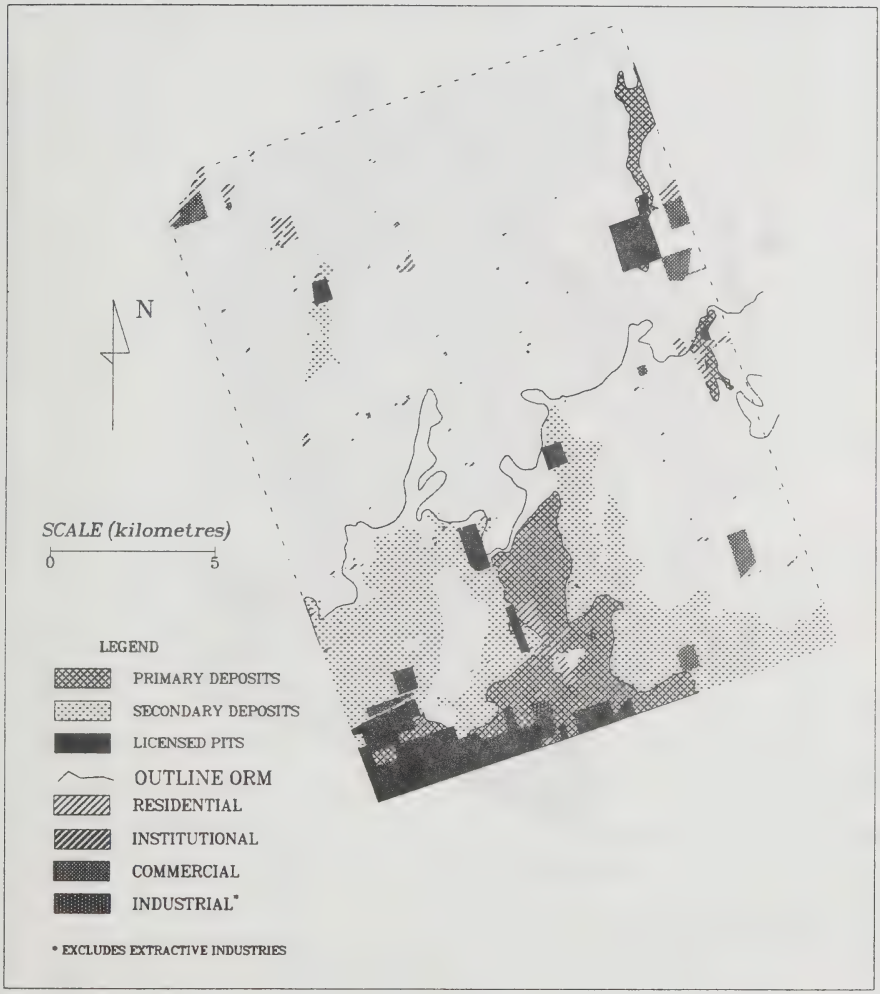


Figure 19
Aggregate Resource Development Constraints
Township of Manvers
Very Serious Constraints

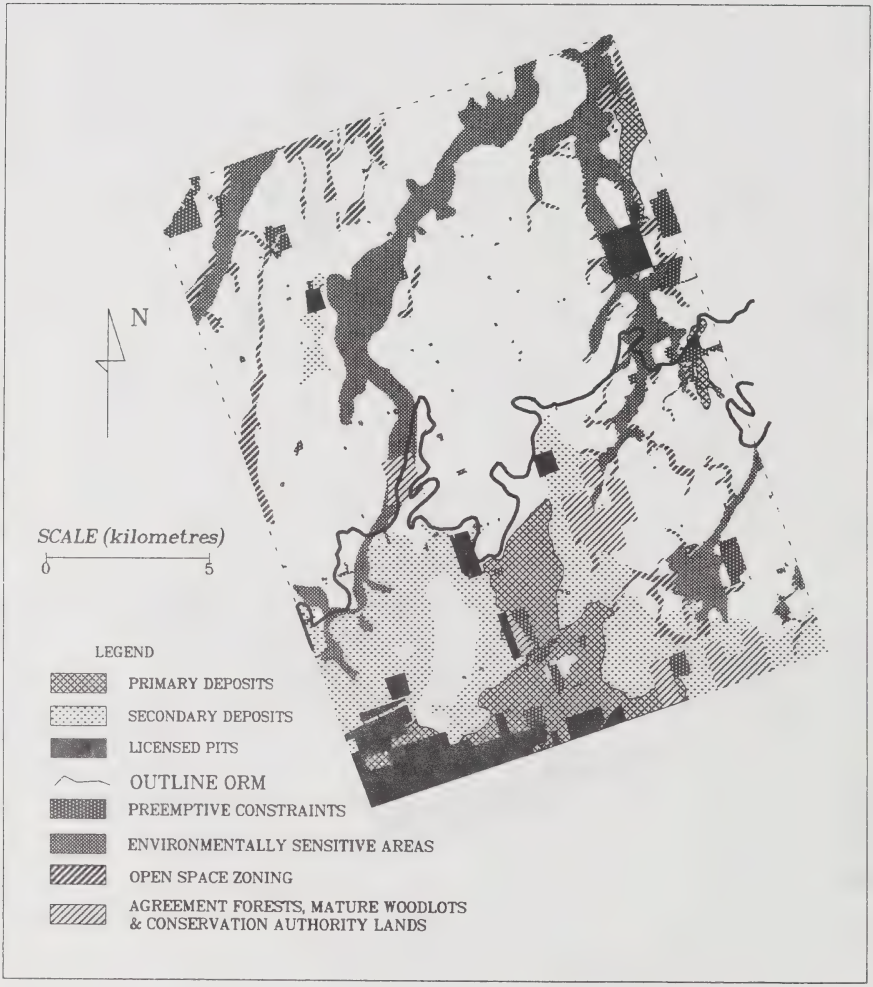
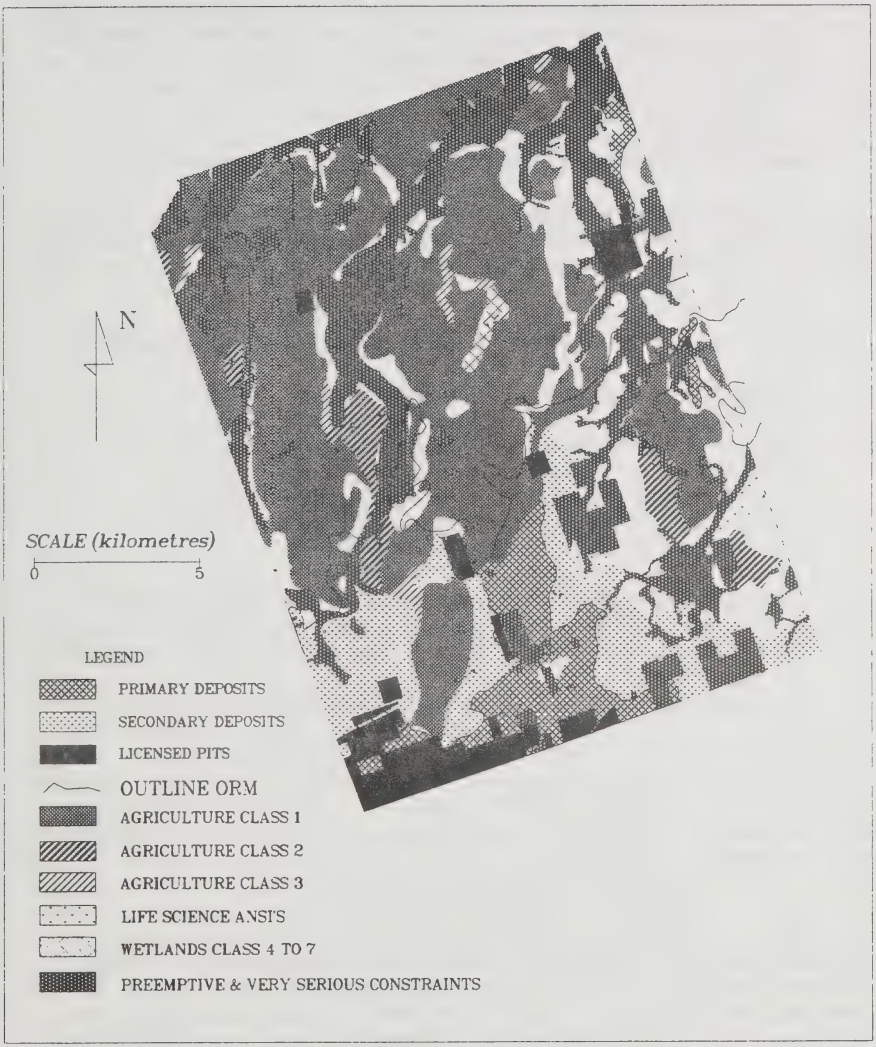


Figure 20
Aggregate Resource Development Constraints
Township of Manvers
Competing Land Uses



There has been a considerable loss of potential resource areas to preemptive land uses in each of these municipalities. The degree of competing land uses is much higher in the Town of Whitchurch-Stouffville than in the Township of Manvers.

The degree to which potential resources are impacted by the very serious constraints and competing land uses demonstrates the uncertainty about access to the resource for future development. The amount of the resource (outside of the preemptive land use areas) that may be available for future aggregate development can only be estimated. There may be additional resource loss due to unidentified constraints or constraints that were not considered in these analyses.

3.5.5 Constraints not Considered in Whitchurch-Stouffville and Manvers

Limitations in available data preclude the consideration of many constraints that a prospective aggregate producer should use to evaluate a property and that might be considered by the municipality and provincial agencies prior to approving either the land use or licensing of the property under the ARA.

The following is a partial list of the constraints not included in the above analyses:

* recent official plan and zoning changes not identified at the time of this compilation
* restrictions due to construction and fill control mapping
* habitat of rare, threatened and endangered species
* housing on rural lands and appropriate setbacks
* setbacks from residential and other incompatible land uses
* roads and utility corridors and associated setbacks
* geological limitations (quality and quantity) of the resource
* minimum land area required for economic and operational development
* land costs or willingness of owner to sell or lease rights to the resource
* proposed natural heritage system and connecting links between natural areas (e.g. greenbelts)
* access to economic haul routes to service market/demand area.

These additional constraints would have to be carefully assessed, and the areas re-calculated before a true estimate of the potentially available resources could be determined. As such, the numbers presented in the preceding constraint analysis are maximum areas of potentially available resources and therefore in excess of what is truly available as potentially developable resources.

3.6 TRANSPORTATION OF AGGREGATES

Transportation is a major component in the supply of aggregates to the market area, given that aggregates are a high volume commodity and generally of low unit value. Most aggregates reach the end user or consumer by road delivery in trucks. As near market supplies became more restricted, other modes of transportation have been utilized (i.e. rail and water).

3.6.1 Modes of Transportation

Roads

The most common means of aggregate transportation in Ontario is by trucks. Truck transportation represents 97 percent of the aggregate movements in the province (Planning Initiatives Ltd, 1993). Trucks provide the greatest degree of versatility to fulfil the "just-in-time delivery" to the aggregate market and also minimize rehandling.

Aggregates are typically consumed in large volumes. These high volumes require large production and storage areas typically found at the sites of production or at plants producing manufactured products (e.g. ready mixed concrete, asphalt or concrete products).

Due to the added cost, rehandling of aggregate materials is avoided, except when used in value-added (manufactured) products that can be sold at higher per unit values.

Rail

Rail transportation is used much less frequently due to:

* a lack of economic competitiveness for short rail hauls (materials must be rehandled and placed on trucks for delivery to most job sites)
* abandonment of railway lines that may have served new or future aggregate operations
* an aging and limited fleet of hopper rail cars
* a lack of economic incentives for rail companies to invest in equipment and infrastructure to compete for short hauls (i.e. less than 300 km).

In southern Ontario, rail has become less important as an aggregate transporter, with only one aggregate supplier using unit trains to move crushed limestone products from the Orillia area to Metropolitan Toronto.

Both CP Rail and CN Rail still move considerable amounts of rail ballast aggregates used on their railway tracks where little rehandling is required.

Water

Water transportation along the Great Lakes is occurring to a certain extent but this mode has financial and technical limitations. For example, Toronto Harbour has received aggregates shipped by lake freighter from Manitoulin Island. This material was mainly utilized in the production of asphalt and concrete consumed mostly near downtown Toronto. Distribution by truck may not be practical to areas outside of downtown core due to highway traffic congestion. In addition, the cost advantage of delivery of aggregates to this area by ship has recently been greatly diminished by increased costs of in-harbour rental fees and seaway transportation levies.

3.6.2 MTO Transportation Costs by Truck

Table 14 indicates the rates for specific distances for MTO contracts. An incremental distance increase from 10 to 100 kilometres will increase the transportation cost four-fold (e.g. from $2.03 to $8.11).

Pit operators in the ORM(GTA) responding to the APAO Operator Questionnaire indicated that only 40 percent of their production was transported more than 50 kilometres. An approximation of the average delivery cost of aggregates 50 kilometres is $5.21 per tonne using MTO contract rates.

Table 14

Truck Haulage Cost Per Tonne of Aggregate
1992/93 MTO Contracts

DISTANCE (KM)	10	20	30	40	50	60	70	80	90	100	110	120	130
COST ($)	2.03	3.18	4.00	4.63	5.21	5.79	6.37	6.95	7.53	8.11	8.69	9.27	9.85

Source: Ministry of Transportation, Ontario, 1977, Contract Design Estimating and Documentation, Volumes 1 and 2. These values are revised annually.

3.6.3 Implications of Increased Transportation

If the haul distance of 50 kilometres was increased to 100 kilometres, the cost would be $8.11, a 56 percent increase in the delivery cost. Similarly, an increase in the haul distance to 130 kilometres would inflate the delivery cost to $9.85, an increase of 89 percent.

The impact of increased transportation on local construction activities can be significant. For example, an average size home of 185 square metres (2000 square feet) in a typical new subdivision requires approximately 440 tonnes of aggregate and a typical two lane highway, 15,400 tonnes (Part 1, Appendix C). The total delivery costs using these two scenarios and increasing haul distances are summarized in Table 15.

The increased construction costs due to increased haulage of aggregates required for a school, hospital or an apartment building, which require substantially more materials than a home, would be proportionally higher.

A truck with an average load of 35 tonnes consumes approximately one litre of fuel per kilometre of travel. The amount of pollutants produced by a truck travelling one kilometre through a composite of local and highway driving and burning heavy diesel fuel has been determined by the Ministry of Environment to consist of nitrogen (15.2 gm), carbon monoxide (6.8 grams) and volatile organics (1.6 grams).

Table 15

Examples of Truck Haulage Costs

Distance	Delivery Cost (per tonne)	Cost per Home (440 tonnes)	Two Lane Highway Cost Per Lane Kilometre (15,400 tonnes)
10 km	$2.03	$ 893.20	$ 31,262
50 km	$5.21	$2292.40	$ 80,234
100 km	$8.11	$3568.40	$124,894
130 km	$9.85	$4334.00	$151,690

The cumulative pollution impact of moving for example 10, 20 and 50 percent of the current ORM(GTA) production is shown in Table 16. The atmospheric loading by the addition of pollutants due to increased truck haulage is significant and can be measured in tens and hundreds of tonnes on an annual basis.

Table 16

Annual Increased Pollutants due to Increased Haulage

Distance	**Truck Loads** (% Production)	**Nitrogen Oxides** @15.2 gm/l	**Carbon Monoxide** @6.8 gm/l	**Volatile Organics** @1.6 gm/l	**Total Pollutants** @23.6 gm/l
40 km	25,000 (10%)	15.2 t	6.8 t	1.6 t	23.6 t
60 km	50,000 (20%)	45.6 t	20.4 t	4.8 t	70.8 t
80 km	50,000 (20%)	60.8 t	27.2 t	6.4 t	94.4 t
60 km	100,000 (40%)	91.7 t	41.0 t	9.6 t	142.3
80 km	100,000 (40%)	122.2 t	54.7 t	12.9 t	189.8 t

Note: (% Production) = percent of ORM(GTA) average annual production of 8.8 million tonnes
Truck load assumes an average of 35 tonnes per load

Increased haul distances in general mean more trucks are required to deliver the same amount of aggregates as each truck must spend more time on the road to deliver each load.

More trucks would travel over more highway kilometres and cause more wear and tear and increase the need for more highway maintenance and reconstruction. There would be more trucks affecting more people and more complaints about truck traffic if the sources are farther away from the site of end use.

3.7 ALTERNATIVE NEARBY AGGREGATE SOURCES

There are two other alternative sources for natural aggregates other than the traditional surface extraction in pits and quarries. For example, underground mining and sand dredging in Lake Ontario are alternatives to supply some of the aggregate demands of the GTA market area.

3.7.1 Underground Mining

Subsurface or underground mining of aggregates has proved to been technically feasible in many parts of the world (Planning Initiatives, 1992). Ontario Hydro (1986) recommended in a report that while it is technically feasible, a detailed economic study was required to determine the financial viability of underground mining beneath Lake Ontario to supply aggregates to the GTA market area.

Suitable bedrock units are the Gull River and Bobcaygeon formations which are located about 300 metres below the surface of Lake Ontario.

While there has been some general interest for consideration of such an operation, no formal applications have been made to commence underground mining. Such a venture would require an approval under the Mining Act. In addition, land adjacent to the lake would have to be acquired to provide access to the underground.

The costs of underground mining exceed those of surface mining and may be as much as two to three times the cost of quarry operations. To be economically viable, the additional cost of underground mining would have to be offset by a reduction in the cost of transportation. Underground mining may therefore have a potential to compete with surface extraction but it may be limited to a very localized market area surrounding the mining site. The ability to compete in a larger or regional market areas may be precluded as costs of trucking. The economic and technical viability of a local underground aggregate mining operation has not been established in Ontario.

3.7.2 Sand Dredging

Sand dredging operations have a history in Ontario that date back at least to 1916 and few complaints have been made against the present operations (Planning Initiatives, 1992). In 1990 there were only three dredging operations in Ontario producing aggregates as follows:

* sand from the Niagara Bar, at the mouth of the Niagara River in Lake Ontario (1989 production was 95,000 tonnes)

* sand from the Ottawa River, near Petrie Island (1989 production was 327,000 tonnes)

* sand and gravel (285,000 tonnes in 1989) dredged from Whitefish Bay in Lake Superior.

In 1992, MNR received an aggregate permit application to dredge sand from Lake Ontario for delivery to Toronto Harbour. Dredging was proposed for a 14 square kilometre area located 1.5 to 2.5 kilometres offshore and 12.5 kilometres by water from Toronto Harbour. The estimated production was between 250,000 tonnes and a maximum of a million tonnes per year. The permit, if issued, would be for 5 years and subject to renewal. Issues raised during circulation for comments on the application are concerns about:

* changes to coastal processes and the potential for increased shoreline erosion

* disturbance and resedimentation of pollutants and the effects of this on fish habitats and the potable water supplies drawn from Lake Ontario.

The applicant is presently conducting on-going studies to address these issues. The success of this venture may determine the viability of sand dredging as a means to supplement the on-shore supplies of sand such as those from the Oak Ridges Moraine.

3.8 RESOURCE CONSERVATION

Since the mid 1980s, there has been an increasing awareness of the value of recycling. This has been particularly evident with newsprint and glass and metal containers. A similar awareness for recycling has occurred within the aggregate industry and opponents of new aggregate extraction operations have suggested that recycling can eliminate the need for new extraction. While recycling and substitution of other materials for aggregates is important, it can not eliminate the need for new aggregates.

3.8.1 Current Recycling (1991 Conservation Study)

The Ministry of Natural Resources recently released a recycling report, entitled Mineral Aggregate Conservation Reuse and Recycling (Emery Geotechnical Engineering Limited, 1991). This study provided insight into conservation efforts by the aggregate industry. Its major findings were as follows:

* wastes and byproducts commonly used in construction as aggregates are old asphalt, old concrete, blast furnace slags, steel slag, nickel and copper slags, fly ash and bottom ash (Table 17)

* other wastes of potential interest and use are kiln dusts, foundry sand, demolition waste, and mine waste rock.

Table 17

Ontario Wastes and Byproducts
Use and Availability, 1990

Wastes and By-Products	W/B*	1990 Amount Used (000s tonnes)	Availability (000s tonnes) Prod'n/yr	Stockpiled
Old Asphalt	W	1364	NA	1493
Old Concrete	W	968	NA	776
Blast Furnace Slags	B	1375	1650	>25000
Air-Cooled	B	575	550	>25000
Pelletized	B	700	700	0
Granulated	B	100	400	450
Steel Slag	B	488	638	5000
Nickel and Copper Slags	B	1000	1700	2900
Air-Cooled	B	1000	1000	400
Granulated	B	0	700	2500
Fly Ash	W	195	924	>12800
Kiln Dusts	W	NA	204	>740
Cement	W	NA	132	>600
Lime	W	NA	72	140
Bottom Ash	W	70	120	0
Foundry Sand	W	NA	267	NA
Mining Waste Rock	W	NA	2500	>196000
Demolition Waste	W	NA	300	NA
Waste Shingles	W	Minor	200	NA
Waste Tires	W	Minor	100	NA
Waste Glass	W	Minor	100	NA
Miscellaneous, Small Quantity	W	Minor	NA	NA
Miscellaneous, Future Potential	W			NA

* Category: W = Waste, B = By-Product

Notes: 1. Miscellaneous, Small Quantity includes - waste brick, waste wood, waste plastic, waste paper; waste ceramics/refractories, ligins, resins, etc.
2. Miscellaneous, Future Potential includes - surplus sulphur, sulphate wastes, clean dredge spoil; decontaminated soil, high temperature incinerator.

Source: John Emery Geotechnical Engineering Limited, 1991

* wastes and byproducts for bulk and cementitious applications provided 6 million tonnes, or 3 per cent, of Ontario's aggregate production in 1990

* approximately 70 per cent of the annually available wastes and byproducts of interest are being used in bulk and cementitious applications

* Ontario's total wastes and byproducts generation totalled 11 million tonnes in 1990

* three of the 11 million tonnes are not within an economically feasible haul distance, or are of marginal quality for use as an aggregate substitute

* the road construction industry is currently making good use of economically available, technically suitable wastes and byproducts as aggregates

* the forecast estimate for use of wastes and byproducts in construction by 1995 ranges from six to nine million tonnes or three to five percent of Ontario's forecast aggregate production.

One of the leading factors in promoting recycling of construction debris into aggregate materials, particularly in the GTA, has been the increase in tipping fees at landfill sites. Tipping fees have made the cost of recycling viable, particularly if disposal fees are in the range of $150 to $200 per load of construction debris.

The contribution of wastes and byproducts use and recycling as aggregate, while important to resource and landfill conservation, makes up only a small percentage of the overall demand for aggregates. Recycled materials suitable for use as a substitute for new aggregates are simply not available either in sufficient quantities, the necessary quality or in a suitable location to replace the need for new aggregates. Access to continued supplies of aggregates must therefore continue, in order to meet the provinces continued demand for these construction materials.

3.8.2 MTO Conservation Measures

MTO practices several effective measures to ameliorate the effects of aggregate extraction by reducing consumption of sand and gravel and crushed rock. The practices include:

* recycling initiatives (see Part 1, Appendix F)
* highway design innovations (see Part 2, Appendix F)
* new laboratory test procedures (see Part 3, Appendix F)
* highway trial test sections (see Part 4, Appendix F).

These practices contribute significantly to the conservation of aggregates. For example, on average between 1988 and 1991, MTO utilized 270,000 tonnes of Reclaimed Asphalt Pavement (RAP) per year in hot mixed asphalt pavement. In MTO's Central Region, RAP represented on average 8.6% (42,000 tonnes) of the total pavement laid in that region per

year over the five year period of 1988 to 1992 (Table 18). The future potential of recyclable materials for MTO Central Region is described in Part 5 of Appendix F.

Table 18

Reclaimed Old Asphalt Pavement (RAP) Used by MTO Central Region (000s tonnes)

Year	Total Asphalt Pavement Used	Total Asphalt Pavement That Included RAP		Total RAP Used	
	tonnes	tonnes	percent	tonnes	percent
1988	503.7	116.4	23.1	46.6	9.3
1989	470.4	163.8	34.8	65.5	13.9
1990	568.9	49.5	8.7	19.8	3.5
1991	429.0	114.6	26.7	45.8	10.7
1992	466.4	81.2	17.4	32.5	6.9
Annual Average	**487.7**	**105.1**	**21.9**	**42.0**	**8.6**

3.9 LICENSED AGGREGATE RESOURCES IN THE OAK RIDGES MORAINE

The aggregate resources of the Oak Ridges Moraine, as previously discussed, have a distribution that is controlled by their geological depositional history. The Oak Ridges Moraine is the largest source area for sand and gravel resources in southern Ontario, a fact illustrated by being the location of a large number of established licensed aggregate operations (Figure 21).

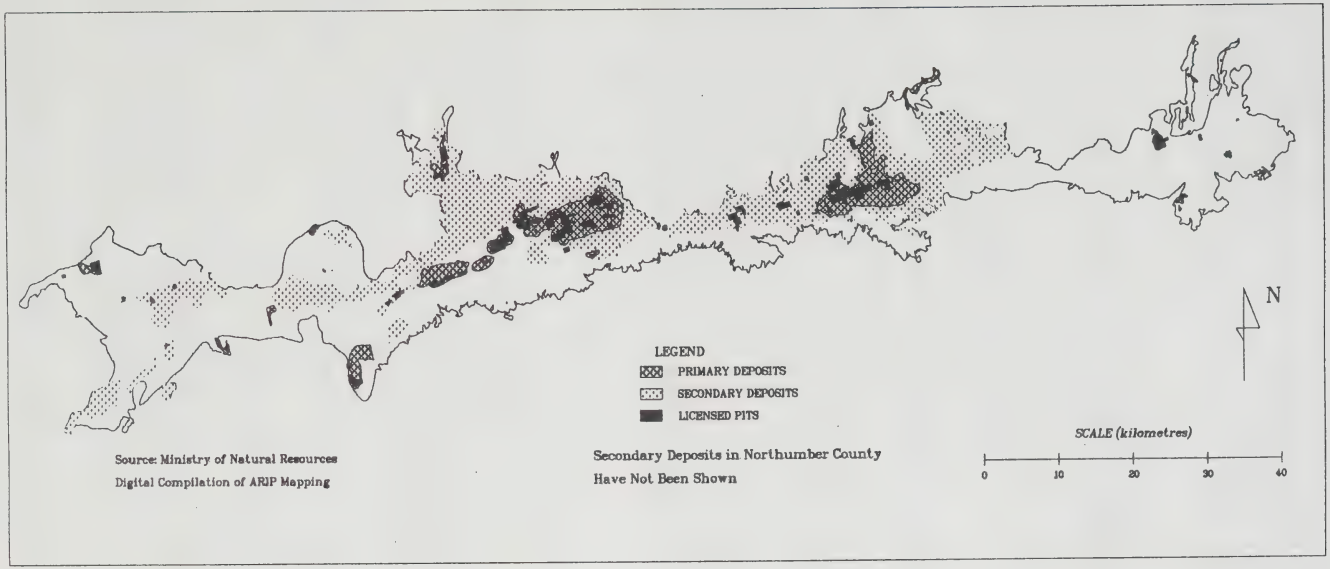
3.9.1 Comparison to Licensing in Ontario and the GTA

Table 19 sets out a comparison of the number and area of aggregate licences for each of Ontario, the GTA, the ORM and the ORM(GTA). Trends in licensing over the 1986 to 1991 period show:

* an increase in the number of licences for Ontario until 1990
* a decrease in the number of licences within the GTA, ORM and ORM(GTA) since 1988
* an overall decrease in total area licensed for all three areas since 1987.

Figure 21

Potential Sand and Gravel Resource Areas and Location of Licensed Pits on the Oak Ridges Moraine



For each of these areas, the average area per licence has remained relatively constant over the 1986 to 1991 period.

The decrease in the number of licences and the total licensed area may in part be a reflection of:

* the current recession
* stringent licensing requirements under the ARA
* a depletion of reserves.

Table 19

Aggregate Licences & Total Areas
Ontario, GTA and the Oak Ridges Moraine

	1986	1987	1988	1989	1990	1991
Number of Licences						
Ontario Total	2,627	2,647	2,683	2,716	2,768	2,755
Greater Toronto Area (GTA)	233	232	233	230	227	222
Oak Ridges Moraine (ORM)	137	138	140	138	133	133
ORM(GTA)	98	99	101	100	95	95
Licensed Area						
Ontario Total	83,557	82,500	76,918	76,918	81,185	81,542
Greater Toronto Area (GTA)	10,679	10,779	10,386	10,386	10,419	10,507
Oak Ridges Moraine (ORM)	6,058	6,166	5,958	5,958	5,944	5,917
ORM(GTA)	4,452	4,548	4,340	4,340	4,322	4,290

3.9.2 APAO Operator Questionnaire

The APAO conducted a survey (Part 1, Appendix B) of each pit operation on the ORM(GTA). This data, plus estimates generated by MNR, MTO and the APAO (where operator data was incomplete or lacking), has been used to provide the following summary of licensed reserves within the ORM(GTA) and more generally on the ORM.

There was a good response to the APAO Operator Questionnaire (Part 2, Appendix B). The respondents represent 80 percent (3442 hectares) of the total licensed area (4290 hectares) on the ORM(GTA) and the majority of the production capacity for the ORM(GTA).

3.9.3 Estimated Quantity of Licensed Reserves

The data from the APAO Operator Questionnaire (sample included in Part 3, Appendix B) was compiled to provide an estimate of the quantity of licensed reserves (Table 20) remaining in the licensed pits within the ORM(GTA). The reader is cautioned that the data is not based on detailed geological calculations of reserves and therefore represents only an approximation of reserves. **The data presented should not be used in a manner to reach conclusions beyond those presented in this report.**

The responses from operators in the ORM(GTA) (see Table B-1, Part 3, Appendix B) indicate that on average:

* 43 percent of the licensed area either contains no reserves, has been depleted of reserves or contains resources that are not available for extraction
* proven reserves make up only 40 percent of the licensed area.

Table 20 also includes a summary of data generated by MNR and MTO for operators that did not respond. For the non-respondents, ministry and APAO estimates indicate that, on average, more than 54 percent of those licensed areas do not contain reserves (see Table B-2, Appendix B). There was insufficient data available to estimate the amount of proven reserves for these licences.

Table 20

Summary of Licensed Reserves in the Oak Ridges Moraine - GTA Portion

	Operators' Responses	Estimates for Operators Not Responding
Licensed Area (hectares)	3442	625.06
No Resources	8.81%	1.81%
Depleted Resources	27.11%	49.48%
Unavailable Resources	7.15%	3.24%
Possible Resources	21.16%	25.34%
Proven Resources	40.35%	Not Available

Note: The total of percentages compiled from operators' responses exceeds 100%; however, this error is not considered significant enough to invalidate the information.

The estimated total of proven reserves amongst the responding operators is slightly less than 159 million tonnes.

3.9.4 Average Annual Production and Operational Life Expectancy

For licences within the ORM(GTA), the 59 operators responding to the questionnaire reported:

* a total average annual production of 8.8 million tonnes for the 1987-1991 period (verified by relatively similar MNR statistics in Table 2, Chapter 2)
* 10 licensed properties maintain limestone depots on site
* 9 of the limestone depots blend the limestone with on-site sand and gravel.

The average life expectancy of these 59 operations has been calculated by dividing the total estimated proven reserves by the combined average annual production. This indicates that these properties have an average of 18 years of production capacity at their current levels of production. If the same rate of increase in production for the GTA, as forecasted in Table 5, Chapter 2, is applied to the rate of production for these operations, the life expectancy is reduced to 16 years.

These numbers however, may be misleading since they do not account for:

* licensed properties that may be nearing depletion
* changes in demand, either locally or regionally, that could affect the rate of depletion
* the current ARA Replacement Site Plan process which may affect the area available for extraction on some licences
* identification of additional reserves not previously known on the licensed property
* operators with extensive reserves who may choose not to develop licensed reserves
* operators who may choose to operate at a reduced capacity to extend the life of their operations
* added capacity due to on-site blending of off-site material that may increase the production capacity and life expectancy
* other licences that are depleted resulting in the transfer of demand to the remaining licensed operations, and decreasing their reserves at an increased rate.

Any of these factors could extend or reduce the life expectancy. Factors that reduce the life expectancy of any particular operation will result in greater pressure (depletion) on other licensed operations.

3.9.5 Location and Distribution of Aggregate Operations in the ORM(GTA)

Licensed pits within ORM(GTA) (Figure 21) are established predominantly on primary sand and gravel deposits with a few being located on secondary deposits.

Licensed extraction operations are scattered throughout the ORM(GTA) with greater concentrations occurring in areas containing the highest quality aggregate resource. The Town of Whitchurch-Stouffville and the Township of Uxbridge represent the major resource development areas from a regional and provincial perspective. The location of these and future operations has been influenced by the following factors:

* The presence of the aggregate resource itself is the primary determinant since aggregates are located only in specific areas as determined by the depositional history of the moraine.

* Ready access to an adequate transportation network is required if an operation is to be competitive and survive financially.

* The area of potential resources must be generally free of, and often some distance removed from, environmentally sensitive areas, unique features, urban centres, concentrated rural residential development or other preemptive land uses.

Further, a multitude of site specific deterrents such as local land use constraints (discussed in Section 3.5) can influence or limit the establishment of an aggregate extraction operation.

3.10 AVAILABILITY OF AGGREGATE SUPPLY FOR THE GTA

The availability of aggregate supply is governed by the remaining amount of licensed reserves and access to materials for municipal and provincial projects by wayside permits. There are a series of issues affecting future aggregate supply in the GTA, including access to resources within the Oak Ridges Moraine.

3.10.1 Current Supply

The majority of historical production in the GTA has been from natural aggregate deposits located close to the GTA market area. The GTA can in general be divided into two sub-demand areas:

* GTA East
* GTA West

Highway 11 (Yonge Street) has historically been a dividing line between these areas. The main reason appears to have been transportation constraints (i.e. traffic volume and congestion) that has made the interchange of substantial amounts of aggregates difficult. There is some interchange across this boundary line; however, the amounts are minor in comparison to the overall consumption and production of aggregates.

Currently, the GTA is supplied with quarried stone products:

* produced from the Amabel and Lockport Formations located along the Niagara Escarpment

* shipped into the GTA from sources near Orillia and in the Carden plain, east of Lake Simcoe
* shipped in from more distant sources west or east of the GTA, but most of which are speciality products (e.g. dense fiction coarse aggregates used in skid resistant asphalt on the 400 series of highways).

Sand and gravel supplies to the GTA come from sources:

* mostly within the GTA, including sources in the ORM(GTA) and from areas in or near the Niagara Escarpment Plan Area (NEPA)
* located to the north of the GTA (e.g. the Orillia area)
* west or east of the GTA including sources on the ORM outside the GTA.

3.10.2 Wayside Aggregate Supply From the ORM(GTA)

Wayside permits are issued under the ARA for specific municipal or provincial construction projects. These are temporary uses most frequently related to road construction and maintenance purposes. Although the ORM is a large geographical feature, it also contains some relatively small aggregate deposits. These smaller deposits are generally classified as deposits of secondary significance and commercial development is not viable. As a result these deposits are suitable only for use on temporary projects. Such deposits are usually identified at the time when a need has been established for road projects. The Aggregate Resources Act and the joint MNR/MTO wayside clearance procedures (including public consultation) provides for a timely and orderly availability of wayside extraction sites for use on MTO and municipal construction contracts. The use of wayside pits contributes to effective resource management ensuring that smaller deposits nearest the point of end-use are utilized and that higher quality materials are reserved for higher quality products.

3.10.3 Issues Affecting Future GTA Aggregate Supply

Future decisions stemming from the Niagara Escarpment Five-Year Plan Review are being closely watched by the aggregate industry and may have a major influence on future availability of resources, particularly quarried stone.

Crushed gravel from the primary deposits in the ORM competes with all but the highest quality stone products. In addition, sand from the ORM is required in the production of high quality asphalt and concrete products where it is combined (blended) with crushed stone.

The State of the Resource Study (Planning Initiatives Ltd., 1993) has concluded that it takes on average from 3 to 8 years to obtain the necessary planning approvals and a licence. It also concludes that "Southern Ontario is moving towards a critical economic, social and environmental situation in terms of access to aggregate resources to meet the increasing demands of Ontario residents".

If this situation is to be avoided, it is necessary to start planning for the development of additional resource areas to replace the current depleting licensed supply. Within the GTA,

the Oak Ridges Moraine represents the most significant source of current aggregate supply and the largest area of potential resources for future aggregate development. It is also within a reasonable haul distance of the GTA market demand area.

3.10.4 Importance of the ORM(GTA) as a Future Supply Source

There are limits on the available information for aggregate resources and land uses. Without access to this information it is not possible to determine the volume of reserves available in order to validate any decision to limit access to these reserves. There is, however, a continuing demand for these materials, particularly within the GTA, and a need for continued access to as much of the potential resource as is reasonable. Continued access to as much of the remaining potential resource as possible would ensure an adequate availability of resources. This strategy is recommended for adoption in the ORM(GTA) and for other resource areas outside the GTA.

The ORM(GTA) contains the largest primary and secondary deposits of sand and gravel in Ontario. With the forecast in demand for aggregates in the GTA, access to this resource area is critical. This is particularly important if aggregates are to be available at a reasonable cost.

There are other potential resource areas that could supply the increased aggregate needs of the GTA. These areas are more distant and subject to many of the same constraints as are the potential resource areas in the ORM(GTA). There is no assurance that the resources in these areas are technically acceptable or can be licensed. Use of limestone from the Carden plain cannot substitute totally for ORM(GTA) sand and gravel materials. The ORM(GTA) sands and gravels are still required for blending with the limestone to produce specification materials.

The GTA is presently consuming more than it produces. For example, in 1988 and 1989, 40 percent of the aggregates consumed in the GTA were imported from surrounding areas. The continued shift of the burden of production to areas outside of the GTA is:

* environmentally and economically expensive
* needlessly depleting materials in the surrounding areas while local resources remain under utilized.

3.11 SUMMARY

1) Access to aggregate resources is limited by their geographic distribution, quality, quantity and availability for extraction.

2) Within the GTA, the ORM(GTA) represents the most significant source of sand and gravel and has the most significant potential to supply future demand.

3) The majority of licensed pits are located within the primary and secondary resource areas.

4) The area of land within the ORM(GTA) that is licensed for extraction under the Aggregate Resources Act (ARA) has decreased since 1987.

5) The area licensed under the ARA is not an accurate indicator of available supply, as "proven reserves" make up only 40 percent on average, of the licensed area. The balance is either depleted, inaccessible, or unproven.

6) Unlicensed aggregate resources of primary and secondary significance exist on the ORM(GTA).

7) The continued availability of both potential primary and secondary sand and gravel resources, for use in a variety of construction applications, is important to ensure optimum product utilization.

8) Blending of ORM(GTA) aggregate (i.e. sand) with imported crushed limestone represents efficient use of these resources and a wise resource management strategy.

9) Since it takes 3 to 8 years to obtain an ARA licence and planning approval, it is necessary to start planning for the development of additional resource areas to replace the current depleting licensed supply.

10) The use of temporary wayside pits, on smaller deposits and those of secondary significance, for highway and road projects contributes to effective resource management.

11) Various land use and environmental constraints exist on all potential resource areas. Continued access to as much of the potential aggregate resource areas as is reasonably possible is required to meet the long term demand for construction aggregates.

12) Transportation costs are the most significant component of the delivered cost of aggregate; therefore, extraction operations should be located as close to market as possible to minimize cost to the consumer and limit the adverse environmental impact of haulage.

13) Transportation costs, both financial and environmental, are minimized by utilizing ORM resources as opposed to more distant sources.

14) There is currently a high level of reuse and recycling of construction wastes and by-products that are combined with aggregates. However, these materials are not available in sufficient quantities to reduce the annual demand for natural aggregates by any more than three to five percent. No other substitute material is available in the volumes required.

15) The use of limestone resources in the Carden Plain and Niagara Escarpment areas does not significantly reduce demand for ORM(GTA) aggregate resources. Sand from the ORM(GTA) will be required for blending with the crushed limestone and dolostone.

4.0 BALANCING SOCIETY'S NEEDS: AGGREGATES AND THE ENVIRONMENT

In the two previous chapters, the importance of past, current and future aggregate production in the ORM to the GTA market area was established. This chapter explains the regulatory framework and efforts by both government and industry toward resource protection and resource utilization in an environmentally acceptable manner.

4.1 POLICY AND LEGISLATION

4.1.1 Mineral Aggregate Resources Policy Statement (MARPS)

The Mineral Aggregate Resources Policy Statement (MARPS) was established in 1986, pursuant to Section 3 of the Planning Act, replacing previous similar government policy. MARPS provides the mechanism to ensure both the protection and future availability of the resource to meet future demand.

The basic principles of aggregate resource management embodied in MARPS are:

* that all land use planning and resource management agencies within the province have regard for the implications of their actions on the availability of mineral aggregate resources to meet future local, regional and provincial needs; and

* that any planning jurisdiction, including municipalities and planning boards, should identify and protect as much of its mineral aggregate resources as is practicable, in the context of other land use planning objectives, to supply local, regional and provincial needs.

The objective of MARPS is to ensure that:

* aggregate resources are available to the general public at a reasonable cost
* existing licensed operations are protected from incompatible land uses
* reserves are designated and available for future extraction.

The role of Provincial Policy Statements has been an issue at various Ontario Municipal Board hearings and at the 1991/92 Niagara Escarpment Plan Review (NEPR) hearing. The NEPR Hearing Officers' Report concluded that:

* "all government bodies involved in the NEP approvals process must have regard to Provincial Policy Statements"

* "all government bodies are obliged to consider relevant provincial policies and give them the appropriate weight in the circumstances of any proposal before them."

This reaffirms that all policy statements are to be treated equally and that only the merits of one versus the other on a site specific basis may result in one taking precedence over the other.

4.1.2 Role of Aggregate Resource Mapping in Land Use Planning

The Ministry of Natural Resources, as set out in the MARPS, is responsible for management of the resource including:

* provision of relevant geological information and resource mapping
* assisting the municipalities to define and protect mineral aggregate resource areas
* provision of comments on proposed planning actions that may have implications for aggregate resource protection.

MNR District Offices have an information role and are responsible for:

* supplying aggregate resource information for use in regional and local municipal official plans
* reviewing and commenting on proposed official plan and zoning by-law amendments relating to aggregate resource management and protection
* protection of other Ministry mandated interests.

The Ministry of Northern Development and Mines is responsible for undertaking mapping of aggregate resources. Their product, Aggregate Resources Inventory Papers (ARIPs), or other similar resource information on file with MNR, are used as the basis for MNR's input to municipal planning.

MNR will normally seek protection of the resource through a request for a land use designation of aggregate resource areas as "Potential Aggregate Resource Areas" on the official plan after taking into account:

* other MNR mandated interests
* other land use objectives and environmental protection
* the local, regional and provincial need for mineral aggregates.

The regional or local municipality may adopt a variety of mechanisms to identify and protect the aggregate resources in accordance with the Implementation Guidelines issued under MARPS.

In addition, MNR would request identification and protection for all legally existing operations (i.e. licensed pits and quarries). Typically, a "Mineral Resources Extraction Area" land use designation would be sought to ensure that these operations continue to operate in compliance with the relevant municipal official plan and zoning by-laws.

4.1.3 Planning Act

In general, the Planning Act enables both upper- and lower-tier municipalities to have direct control over all land use matters. It is the vehicle through which the MARPS is implemented at a municipal level.

Under the Planning Act, municipalities have two main instruments to control land use:

* Official plan designations
* Zoning by-laws

The purpose of official plans is to establish a general, long range policy framework for future land use within the municipality. This policy of future land use is implemented through zoning which:

* establishes the legal permitted uses of a parcel of land
* controls the amount of building coverage on a parcel of land
* controls the height of buildings.

A licence to extract aggregate resources may not be issued by MNR until the required zoning is in place.

4.1.4 Aggregate Resources Act

MNR's aggregate resources program objectives and strategies and the Aggregate Resources Act (ARA) are described in Part 1 and 2, Appendix G.

The ARA represents the 'state of the art' aggregate regulation in North America. The primary purpose of the ARA is to ensure effective management of Ontario's aggregate resources on both Crown and private lands in designated areas of the province. The key aims are to:

* minimize adverse social and environmental impacts
* require progressive rehabilitation of all sites.

On January 1, 1990, the ARA replaced the following legislation:

* Pits & Quarries Control Act
* Beach Protection Act
* Quarry permits under the Mining Act

The ARA has provided many improvements, specifically:

* greater consideration is given to the environment
* progressive and final rehabilitation is mandatory
* higher standards are required for site plans (Part 3, Appendix G)
* a provincial fund for the rehabilitation of abandoned pits and quarries was created (see section 4.4.3)
* financial remuneration to municipalities based on production
* more municipal involvement in licensing and review
* immediate suspension of licences and permits for serious contravention
* flexibility in controls and rehabilitation requirements for Crown land pits and quarries.

The ARA regulates all pits and quarries, including those operated by municipalities and the province, with the following approval instruments:

* Licences (private land in designated areas, Figure 22)
* Wayside permits (private land in designated areas, public authorities only, road projects)
* Aggregate permits (Crown land and land under natural waterbodies).

During proclamation of the Act, MNR was committed to designating all areas of the province. Additional areas will be designated gradually using a phased-in approach as staff and financial resources permit.

4.1.5 Highway Environmental Assessment Process

In addition to the requirements of the ARA, highway construction projects are subject to Highway Environmental Assessments which are conducted in accordance with the requirements of the Environmental Assessment (EA) Act. A "class" environmental assessment process was developed in Ontario in order to apply the requirements of this Act to a group or "class" of undertakings or projects (Section 41 of the EA Act) which:

* are similar in nature
* have common characteristics
* recur frequently
* have a predictable range of effects for which standard mitigation techniques can be used.

MTO's rationale for its 1992 Class EA (a revision of the "Provincial Highways Class Environmental Assessment" 1985 Class EA) is based on:

* the evaluation of the application of its 1985 Class EA for over 200 projects
* a demonstration that the Class EA is a process which works well and which adequately addresses the interests of all those involved.

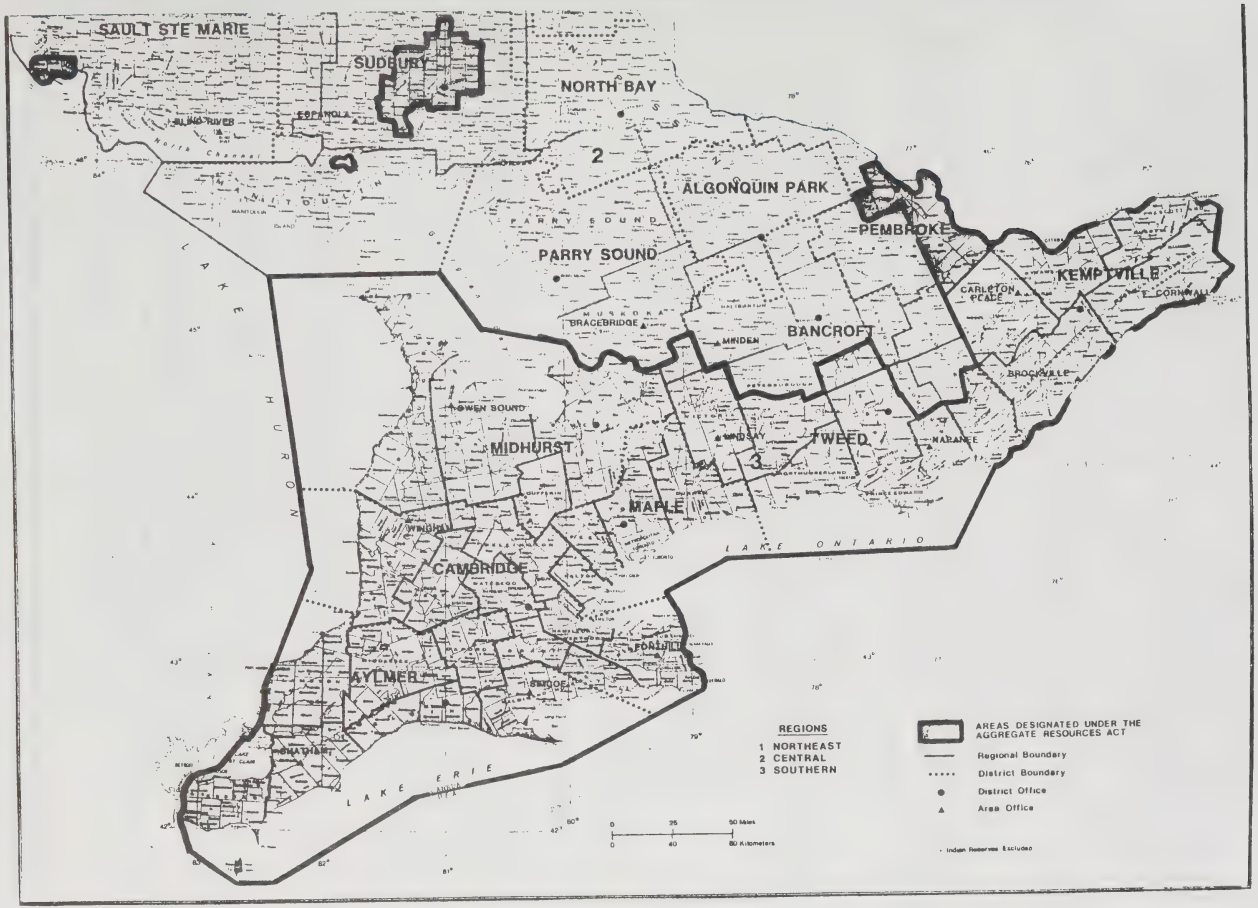


Figure 22: **Areas Designated Under the Aggregate Resources Act**

Part 1, Appendix H, describes MTO's Class EA process and its interministerial protocols and agreements. Of specific interest to the ORM is the Group "D" activity under the MTO Class EA. A major agreement that pertains to MTO is an interministerial procedure entitled, Quality and Standards Directive B-14 (Part 2, Appendix H). This procedure establishes a mechanism for aggregate site selection, operational constraints and rehabilitation. MTO strives for a balanced approach between wayside pit and quarry development and environmental or social concerns by mitigating any effects of these aggregate sources (Katona and Szoke, 1993).

4.1.6 Other Legislation and Policy

In addition to the above regulatory requirements for licensing and land use approval, the following legislation and policies influence the development, protection and rehabilitation of Ontario's aggregate resources:

* Wetlands Policy
* Ontario Water Resources Act
* Municipal Act
* Conservation Authorities Act
* Ontario Foodland Guidelines
* Endangered Species Act
* Gasoline Handling Act
* Environmental Protection Act
* Fisheries Act (Federal) and Policy for Management of Fish Habitat
* Lakes and Rivers Improvement Act
* Occupational Health and Safety Act
* Highway Traffic Act

4.2 ROLE OF THE AGGREGATE INDUSTRY

4.2.1 Employment by the Aggregate Industry

The aggregate industry is a significant employer and, together with the construction industry, is co-dependant on the availability of aggregates for success. Environmental and social awareness amongst industry members is recognized as a key ingredient to ensure continued access to the resources upon which they depend.

In Ontario, the aggregate industry:

* directly employs over 8,200 persons in the production of aggregate materials
* indirectly employs over 40,000 persons employed on necessary services such as transportation, equipment supply and material supply
* has an employment that is seasonal in nature with peak employment corresponding with the active construction season during the months of April-October
* employs 750 persons directly within the ORM and 3,900 persons indirectly
* demonstrates that its Class EA process works well and adequately addresses the interests of all those involved.

4.2.2 Relationship of the Aggregate Industry to the Construction Industry

Aggregate products are the basic building material, a foundation that supports Ontario's construction industry, building material industry and manufacturing industry. Aggregates are:

* utilized directly in construction industry applications
* the primary building materials of ready mixed concrete and asphalt which are composed of over 90 percent aggregate by volume.

Aggregate products supported a value of construction in Ontario exceeding 31 billion dollars in 1990 with over 400,000 Ontario residents directly employed in the construction industry. This investment and employment are dependent upon a readily available supply of high quality aggregate products.

4.2.3 The Aggregate Producers' Association of Ontario

The APAO is a non-profit industry association established in 1956 to represent companies and individuals engaged in the production of aggregate products in Ontario. APAO's current membership:

* represents 128 "active" individual and corporate members directly engaged in the aggregate industry throughout Ontario
* produces over 85 percent of the aggregate materials consumed annually in the province
* also represents 118 "associate" individual and corporate members who are suppliers of goods and services to the aggregate industry.

The primary purposes of the Association are to:

* provide information services to members
* provide direction to the industry on important issues
* act as an advocate for the industry in dealing with government legislation and regulation.

The activities of the Association are directed by member-approved objectives which are detailed in Appendix I.

4.2.4 APAO Member Self-Regulation

Despite being a voluntary organization, the Association has developed a role in establishing industry self-regulation and high industry standards for active members by:

* encouraging and promoting member compliance with all related legislation and policy pertaining to the aggregate industry

* requiring complete disclosure by all new member applicants of any infractions and convictions under relevant legislation such as the Aggregate Resources Act and the Environmental Protection Act
* restricting membership in the Association to those who display a history and commitment to responsible operations
* developing industry standards, beyond the legislative requirements, that all members are expected to pursue.

These standards have been documented in the Environmental Management Manual produced by the Association and are focused in the areas of:

* sustainable development
* corporate environmental principles
* acceptable environmental operating procedures.

A Code of Responsibility is also detailed in Appendix I. The Association has an established Ethics Committee that can revoke membership from those members who do not conduct their business in a manner acceptable to the Association and the public.

4.2.5 Association Committees

The APAO currently operates 18 standing committees comprised of industry representatives with expertise in various areas of industry activity. All standing committees report directly to the Association's Board of Directors.

To address a multitude of industry, government and public issues, the key standing committees include:

* Land Use Planning and Zoning Committee
* Environment Committee
* Rehabilitation Committee
* Reuse and Recycling Committee
* Public Relations Committee
* Health and Safety Committee.

The Environment Committee deals with specific issues such as the Trees Act, the Wetlands Policy Statement, ANSIs and endangered species.

The Association also establishes special committees to deal with specific issues such as:

* the Municipal Industrial Strategy for Abatement (MISA) Committee
* special liaison committees to discuss issues of mutual concern with a variety of government ministries and agencies.

In the area of land use planning and resource development, the Association coordinates the establishment and activities of ad hoc committees to address issues affecting members in

specific geographic areas. Some of these committees are as follows:

* Oak Ridges Moraine Aggregates Committee
* Niagara Escarpment Plan Review Committee
* Region of Durham Plan Review Committee
* Region of Halton Plan Review Committee

4.2.6 APAO and Public Awareness

Inherent in many of the APAO's activities is the objective of increasing public awareness and understanding of aggregate resources and the role of the aggregate industry. The Association acts as an information source for government and the general public through the development of publications such as:

* the Annual APAO Member Directory
* the Consumers' Guide to Construction Aggregates
* the Home Owners Guide to Aggregate.

The Association also delegates representatives to meet with municipal representatives and interest groups to discuss aggregate resource issues and seek consensus on a variety of issues and topics. Association representatives also work with special interest groups such as:

* the Conservation Council of Ontario (CCO)
* the Association of Municipalities of Ontario (AMO)
* the Abandoned Pit and Quarry Rehabilitation Fund Steering Committee

The Association has actively pursued community rehabilitation projects of abandoned sites by providing expertise and funding to return derelict sites to productive after uses such as:

* the MTRCA Boyd Conservation area
* the MTRCA Glenn Majors Project.

The APAO annually presents awards to recognize Association members who undertake rehabilitation projects that result in direct benefits to local communities.

The Bronze Plaque Award Programme has recognized the following nine sites (all having public access) for outstanding rehabilitation projects:

* Royal Botanical Gardens - Hamilton
* Smythe Park - Toronto
* East Park Gardens - London
* Orchard View Golf Course - Leamington
* St. Marys Swimming Quarry - St. Marys
* Peninsula Lakes Golf Course - Fonthill

* Spratt Sand and Gravel Lakeland Estates - Nepean
* Erindale College Campus - Mississauga
* Professor's Lake - Brampton

4.2.7 International Aggregate Associations

Throughout its history, the APAO has maintained direct linkages with other similar industry associations throughout the world, including the following:

* National Crushed Stone Association (U.S.A.)
* National Aggregates Association (U.S.A.)
* Sand and Gravel Association (U.K.)
* British Aggregate and Construction Materials Institute (U.K.)

This reciprocal relationship has assisted in expanding the knowledge base and sharing the experiences of the aggregate industry in areas related to land use planning, environmental issues and rehabilitation techniques.

APAO member companies have won several prestigious awards from these associations for their efforts in rehabilitation, community relations, operating practices, health and safety and environmental protection.

4.3 PREVENTION AND MITIGATION

The use of appropriate preventative and mitigative techniques (Figure 23) to extract aggregate help to protect the environment. The following section describes sources of impacts from aggregate extraction, legal requirements of the industry, and prevention and mitigation measures which are available and are used in many situations. It is not intended to suggest that itemized prevention and mitigation measures be employed in every case, but simply that these possibilities are available and are considered in individual situations.

4.3.1 Air

Noise

Sources of Impacts:

* Stripping of soils and overburden in preparation for extraction of aggregate
* Excavation equipment, processing equipment and trucks (on-site and off-site)

Legal Requirements:

* Environmental Protection Act, section 13(1), " ...no person shall discharge a contaminant ... into the natural environment that causes ... an adverse effect."

Figure 23a : Low profile plant equipment and minimizing disturbed areas reduce the visual impacts of an aggregate operation.

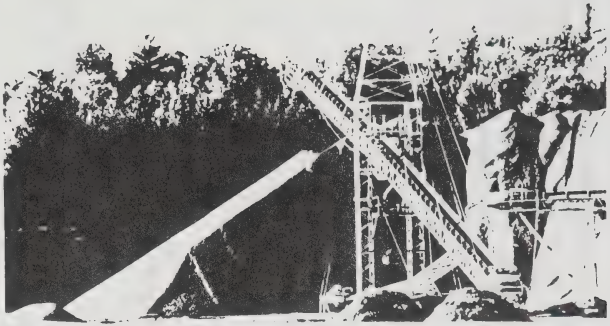


Figure 23b : Retaining natural vegetation around an operation is an effective means to minimize dust, noise and visual impacts.

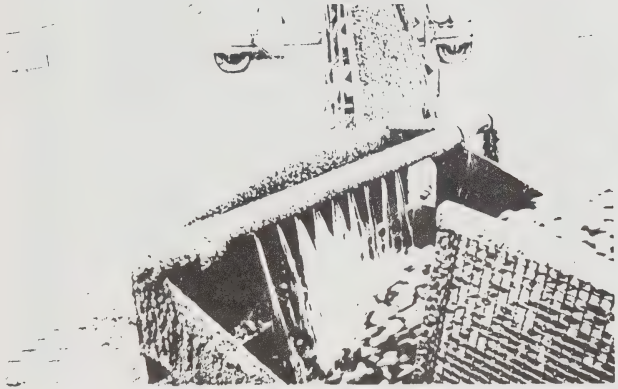


Figure 23c : Spray-bars on processing equipment suppress the generation of dust.

Figure 23d : Application of water or other approved dust suppressants on roads prevent dust problems.

* MOEE has noise guidelines for urban and rural situations: where man-made sounds are dominant, the sound from an aggregate operation should not exceed the ambient sound level at an urban receptor; where the sounds of nature dominate and road traffic is infrequent, the sound from the aggregate operation should not exceed the ambient L90 (sound level exceeded for ninety percent of the time) by more than 10 decibels at the rural receptor
* The operation should be in compliance with the guidelines specified in the MOEE publication "Model Municipal Noise Control By-law, Final Report, August, 1978"

Prevention and Mitigation Measures:

* Designate on-site and off-site haul routes
* Increase use of conveyors on-site instead of trucks
* Siting of processing equipment below surrounding grade
* Electric-powered equipment instead of diesel/gasoline
* Restrict hours of operation
* Urethane/rubber screens and enclose processing equipment
* Earth berms/vegetation buffers and retain natural topographic barriers
* Phasing and direction of mining sequence
* Special mufflers on equipment and avoid "jakes" brakes on trucks
* Sonic sensors that activate only when there is an obstacle in the path of a reversing vehicle may be approved in the near future to replace the legal requirement for use of "back-up beepers"

Dust

Sources of Impacts:

* Disturbed areas (vegetation removed or not yet re-established)
* Excavation and processing equipment; stockpiles and dewatered settling ponds; trucks (on-site and off-site)

Legal Requirements:

* Environmental Protection Act, section 13(1)
* Particulate matter is measured as suspended particulate matter (particles less than 44 microns in size) and as dust-fall
* Ont. Reg. 346, RRO, 1990 (formerly Reg. 308) under the EPA; the maximum concentration for suspended particulate matter is 100 micrograms per cubic metre of air for a half hour average at any point of impingement. The same regulation sets the maximum value for dust-fall at any point of impingement at 8,000 micrograms per square metre of surface area for a half hour average

Prevention and Mitigation Measures:

* Condition on licence or site plan limiting disturbed area
* Progressive rehabilitation of site to reduce disturbed area
* Consider prevailing winds in design of operation

* Avoid crushing extremely dry materials
* Restrict hours of operation
* Pave internal roads and/or haul routes and keep clean
* Apply water, calcium or other dust suppressant on roads
* Designate on-site and off-site haul routes
* Wet suppression systems at point of dust generation such as spray-bars/fog nozzles on processing equipment and conveyors
* Telescopic chutes between conveyor discharges and stockpiles
* Enclose processing/conveying equipment
* Pressurized bag-houses
* Earth berms and vegetation buffers
* Washing of vehicles upon exit from site

Climate

Sources of Impacts:

* Changes in topography due to excavation of aggregate may cause changes to microclimate; proper air drainage is required to prevent the creation of frost pockets in areas where tender fruit crops are grown

Legal Requirements:

* Section 12 of the ARA requires that impacts on agricultural resources be considered in the issuance of a licence

Prevention and Mitigation Measures:

* In areas of specialty crop lands (e.g. the Niagara fruit belt), it is important to consider the microclimatic results when rehabilitating a pit or quarry back to tender fruit production. Proper air drainage is required to prevent the creation of frost pockets

Odour/Emissions (other than dust)

Sources of Impacts:

* Problems of odour are not normally associated with the operation of pits and quarries other than exhaust emissions

Legal Requirements:

* Environmental Protection Act, section 13(1)

Prevention and Mitigation Measures:

* Use of electric generators instead of diesel
* Use of current emission control technology
* Ensure proper settings and maintenance of vehicles/equipment

4.3.2 Land

Landscape (Visual/Aesthetic) Impacts

Sources of Impacts:

* With removal of vegetation, the colour or texture of the landscape is altered, potentially causing landscape impacts from a visual standpoint
* With removal of aggregate, changes to landforms can potentially cause landscape impacts
* Poorly designed/constructed berms can be more unsightly than the view of a pit/quarry
* Size of operations, if not in scale with local surroundings, can cause a visual impact
* Processing plants and vehicles on haul routes can be visually intrusive
* Plant lights can be disruptive to neighbouring residents and to traffic at night
* Erosion from lack of rehabilitation

Legal Requirements:

* While not specifically listed, the ARA requires effects on the environment, amongst other things, to be considered in the issuance of a licence

Prevention and Mitigation Measures:

* Phasing and direction of mining sequence designed to hide operation
* Limit the amount of disturbed area at any one time during operation
* Correct placement of processing equipment and stockpiles
* Earth berms and vegetation buffers
* Retain natural vegetation and topographic barriers
* Progressive rehabilitation
* Well-maintained work area and landscaped entrances and visitors area
* Use of low-profile processing equipment and placement on lowest area following excavation of aggregate
* Use of temporary, fast-establishing vegetation on inactive areas not ready for rehabilitation
* Planting of tree and shrub screens at the earliest time

Natural Features (Soils, Geology, Vegetation/Habitat, Wildlife)

Sources of Impacts:

* Removal of topsoil and subsoil in preparation for aggregate extraction can impact on the quality of farmland
* Removal of vegetation in preparation for aggregate extraction may destroy or alter forests, wetlands, significant geological features or other sensitive habitats or species at risk
* Excavating aggregate (e.g. from old sand pit faces which have become nesting habitat for bank swallows)

Legal Requirements:

* Sections 16 and 23 of Ont. Reg. 15, RRO, 1990, require topsoil and subsoil to be retained on site for rehabilitation
* The Foodland Guidelines is a provincial policy which guides municipal land use planning; where it is proposed to excavate aggregate from Class 1 - 3 farmland, rehabilitation must return the land to the same soil capability unless approval has been issued to extract into the water table; specialty crop lands such as the Niagara fruit belt must be rehabilitated to the same productivity
* The Endangered Species Act prohibits wilful damage of endangered species or their habitat
* Wetlands Policy Statement

Prevention and Mitigation Measures:

* Appropriate rehabilitation measures
* Identify and protect important areas on a site
* Transplant vegetation where practicable
* Create wildlife habitat, including wildlife corridors in rehabilitation efforts
* Restrict timing of excavation of sand faces with known nests
* Identify and protect important habitat areas on the site or restrict specific areas from extraction

4.3.3 Water

Water Quality

Sources of Impacts:

* Toxic contaminants added to surface or groundwater from fuel spills
* Sediment added to surface water from erosion or discharge of process water
* Temperature increases of created water bodies
* Importation of wastes other than inert fill for rehabilitation
* Contamination risk may be elevated by the removal of the natural filtration layer

Note: Water quality may be impacted by sites which dewater or lower the water table by pumping (usually quarries). However, none of the sites in the ORM dewater

Legal Requirements:

* Environmental Protection Act, section 13(1)
* The Municipal Industrial Strategy for Abatement (MISA) program administered by MOEE applies to dischargers of water to surface streams. Presently, no pits discharge in the ORM

The aggregate industry, through the APAO, has been participating in the Ministry of the Environment and Energy's MISA program to:

* assess the quality of surface water discharges from industry
* develop a regulation to eliminate persistent toxins being discharged to the environment.

The basis of the MISA program in the aggregate industry was to monitor, for one year, 20 licensed aggregate operations throughout Ontario, 19 quarry operations and one sand and gravel operation. This monitoring included:

* sampling and parameter testing on a weekly, monthly, and annual basis for over 280 chemicals and compounds identified as environmental parameters by the MOEE
* conducting toxicity testing for all sites and recording discharge flows.

The pre-monitoring surveys by the MOEE determined that:

* only one sand and gravel operation (located in the Thunder Bay area) discharged water from the site
* all sand and gravel operations that contained washing plants, have self contained recycling systems and do not use or introduce any chemicals or agents to the washing process
* "discharges were non-toxic to rainbow trout and Daphnia magna"
* "no persistent toxic chemicals were found in the effluent discharged from these properties"
* "the suspended solids (in discharges from the properties) are composed of ground-up sand and limestone"
* at all 20 sites (19 quarries and 1 pit), water discharges are within Ontario drinking water standards.

As a result of the accumulated technical information and monitoring results, the Minister of the Environment and Energy:

* proposed to grant an exemption to the aggregate industry from the MISA regulation
* still maintains regulatory control on a site-by-site basis under their approval instruments such as permits to take water
* has concluded that aggregate operations do not discharge contaminants into the environment:
  - Ontario Water Resources Act, section 16(1) states "Every person that discharges...any material of any kind into or in any waters...that may impair the quality of the water...is guilty of an offence"
  - ARA, sections 12 (and 26), "The Minister in considering whether to issue or refuse a licence (wayside permit) shall have regard to...any possible effects on ground and surface water resources...."

Prevention and Mitigation Measures:

* Have a thorough understanding of the pre-extraction hydrological regime
* Prohibit use of toxic chemicals in dust suppression
* Reuse/recycle water used in washing/processing of aggregate
* Build settling ponds to settle out sediment in storm water run-off
* Confine refuelling of equipment to areas with suitable containment and protection from spills; develop a spills contingency plan
* Timed discharges to account for various factors, including water temperature, sediment concentrations, low flow periods, spawning periods
* Leave effective natural filter layers between aquifers
* Lessen the impact through progressive rehabilitation

Water Quantity

Sources of Impacts:

* Drainage of a perched water table may have local impacts
* Evaporation from created water bodies (lakes and settling ponds)

Note: Water quantity may be impacted by dewatering or lowering of the water table by pumping (usually quarries). However, none of the sites in the ORM dewater.

Legal Requirements:

* Environmental Protection Act, sec. 13(1)
* Ontario Water Resources Act (1983), sec. 20(3) states "...no person shall take more than a total of 50,000 litres of water in a day,...without a permit...."
* Aggregate Resources Act, sections 12 (and 26), "The Minister in considering whether or not to issue or refuse a licence shall have regard to...any possible effects on ground and surface water resources...."

Prevention and Mitigation Measures:

* Have a thorough understanding of the pre-extraction hydrogeological regime
* Well monitoring programs on sites which excavate below the water table

4.3.4 Cultural Heritage Resources

Sources of Impacts:

* Removal of soil surface layer can alter or destroy archaeological resources

Legal Requirements:

* Ontario Heritage Act
* Cemeteries Act

Prevention and Mitigation Measures:

* Pre-extraction surveys
* Identification by Ministry of Culture, Tourism and Recreation of areas with high potential for archaeological resources

4.3.5 Safety

Sources of Impacts:

Off-site truck traffic causing increased potential for:

* injury from inferior road design, speeding, careless driving by truckers and other road users
* road damage and damage to vehicles from flying stones
* traffic congestion.

Legal Requirements:

* The general rules of highway driving under the Highway Traffic Act (HTA)
* Ont. Reg. 577, RRO, 1990, the HTA requires the covering of trucks carrying certain-sized aggregate and controls axle loading weights for trucks
* Municipal Act and designated haul routes
* The main haulage routes and proposed truck traffic to and from a site are to be considered in the issuance of a licence under the Aggregate Resources Act

Prevention and Mitigation Measures:

* Adherence to and enforcement of existing traffic laws
* Use of designated haul routes
* Road improvements
* Additional turning lanes for deceleration/acceleration

4.4 REHABILITATION

Rehabilitation is probably the single most important measure to minimize the long-term environmental impacts from the disruption of aggregate extraction. Regulatory control through the Aggregate Resources Act and planning control through the Planning Act can guide rehabilitation efforts to facilitate appropriate after-uses which are appealing and beneficial to surrounding natural features, land uses and the local community.

4.4.1 Rehabilitation Concepts

Basic Steps of Rehabilitation

Efforts required to properly rehabilitate a site can vary from the most basic sloping and seeding to more complex efforts such as ensuring proper air drainage where the microclimate of tender fruit crops are a concern. The basic steps to rehabilitation are as follows:

* **Pre-planning**: To properly plan for rehabilitation, it is important to start with detailed base information such as quantities of and variations in the aggregate resource, quantities of topsoil and overburden and groundwater information.

* **Strip topsoil, subsoil and overburden separately**: Small areas should be stripped at any one time and should be coordinated where possible to be used directly in progressive rehabilitation elsewhere on site; soils should be moved under dry conditions.
* **Extraction**: The area of extraction should be kept as small as possible.
* **Grading, contouring and subsoiling**: Subsoiling relieves soil compaction to improve drainage and to promote root penetration in establishing vegetation.
* **Replace overburden, subsoil and topsoil in sequence**: For an agricultural after use, the replacement of soils would normally be spread evenly; for wildlife habitat, it may be desirable to have variation to encourage site diversity. See Appendix J.
* **Re-establish vegetation**: For an agricultural after use, this would include tillage, stone picking, fertilization and proper choice of a grass/legume mixture. Appendix J includes a description of techniques used to enhance biodiversity.

Sequential Land Use

The concept of sequential land use is carried out by requiring progressive rehabilitation and limiting active extraction areas to a minimum practical size. Aggregate extraction is considered an interim land use activity in an overall sequential series of land uses (Figure 24).

Progressive Rehabilitation

It is important to undertake rehabilitation concurrent with pit operations to minimize:

* rehabilitation costs
* double handling of material
* environmental impacts of aggregate extraction.

Figure 25 shows some examples of wayside pits which have undergone progressive rehabilitation.

4.4.2 Regulatory Control

Rehabilitation Considerations in the Licence Application Process

"Rehabilitate", as defined in the ARA, means to treat land from which aggregate has been excavated so that the use or condition of the land is:

* restored to its former use or condition; or
* changed to another use or condition that is or will be compatible with the use of adjacent land.

Figure 24

Schematic of Sequential Extraction and Progressive Rehabilitation

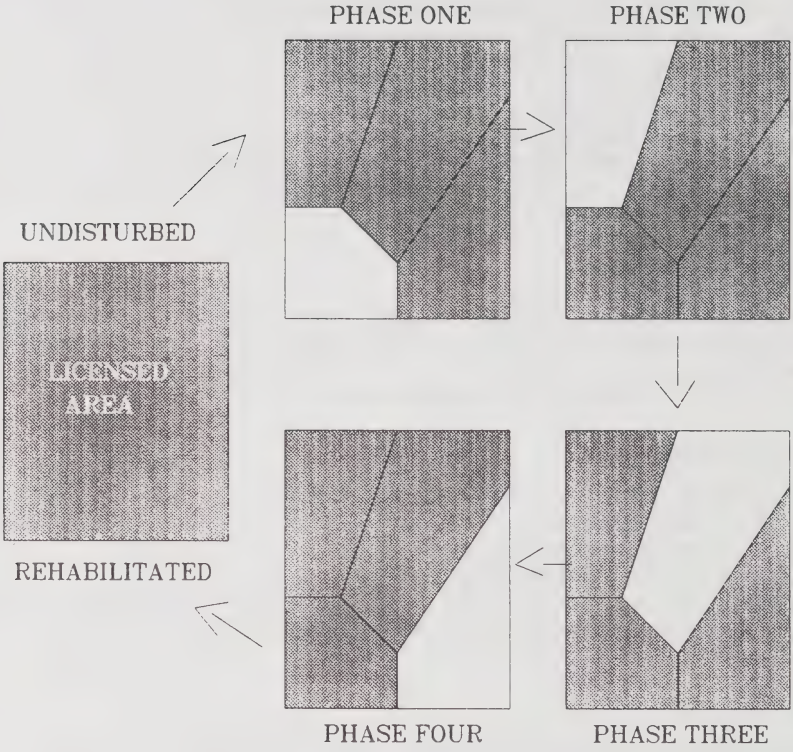


Figure 25 : Progressive Rehabilitation of a Wayside Pit

Figure 25a : Rehabilitated wayside pit immediately after regrading in 1977 (south half).

Figure 25b : Rehabilitated wayside pit immediately after regrading in 1977 (north half). Note old pit at right side which was used earlier and left without rehabilitation.

Figure 25c : View of rehabilitated pit site in 1991.

Figure 25d : View of rehabilitated pit site in 1991 from township road looking west.

Section 8 of the ARA establishes rehabilitation site plan standards. Appendix G (Part 3) contains a photo-reduced copy of sample site plans to assist in site plan preparation.

Matters to be considered in the issuance of a licence in sec. 12 of the ARA includes the suitability of the proposed rehabilitation. It is a proponent's responsibility to propose a rehabilitation plan which will meet:

* the requirements of the definition of rehabilitation
* any planning requirements set out by the municipality which do not conflict with the ARA.

Section 13(5) of the ARA requires compliance with the zoning by-law before a licence can be issued. MARPS encourages municipalities to specify after use requirements in official plans.

Aggregate Resources Act vs. Pits and Quarries Control Act (PQCA)

Considerable improvements in rehabilitation requirements over the old PQCA are contained in the new ARA (January 1, 1990):

* Replacement site plans: all site plans must be updated by December 31, 1993
* MNR may require amendments and conditions on site plans
* Mandatory rehabilitation security for wayside permits
* Rehabilitation of abandoned pits: the PQCA failed to address the legacy of pits abandoned prior to that Act coming into effect
* Progressive rehabilitation is mandatory and enforced by requiring site plans to show how progressive rehabilitation will be done (i.e. tying the timing of rehabilitation to the phasing of operations within a site)
* Rehabilitation standards are strengthened (i.e. pit slopes must be a minimum of 3:1 instead of 1:1); however, the ARA provides the flexibility to override certain standards where it is deemed appropriate

Rehabilitation Security Deposit System

This system is intended to serve as both a financial incentive to the licensee to rehabilitate and as an assurance that public monies will not have to be spent for rehabilitation.

There is currently over $57 million held by MNR as security for the rehabilitation of over 2600 licences. Each licence has a separate account into which is annually paid eight cents for every tonne of aggregate removed in that calendar year subject to two limitations:

* the licensee pays the eight cents/tonne up to a maximum of $6000 per hectare requiring rehabilitation

* the licensee can reduce the deposit to a minimum of $1000 per disturbed hectare if progressive rehabilitation is performed.

Security is refundable once a year as progressive rehabilitation is carried out. The licensee is responsible for full rehabilitation notwithstanding insufficient security.

4.4.3 Rehabilitation in the Oak Ridges Moraine

The graphic Figure 26 compares the area of the ORM(GTA) (128,159 hectares) to licensed area (4290 hectares) and disturbed area (1378 hectares).

Rehabilitation can or will be found in four situations:

* active licences
* cancelled licences
* wayside permits
* at abandoned pits

The graphic Figure 27 shows the licensed area (4290 hectares) and disturbed area (1378 hectares) as of 1992 and rehabilitated area (486 hectares, from APAO survey) to date.

There are currently 95 active licences in the ORM(GTA). The APAO survey indicated that 486 hectares had been rehabilitated to date. MNR statistics indicate that 189 hectares have been rehabilitated in the past six years (1986-91) and in that period, $5.4 million has been spent on rehabilitation (on the completed 189 hectares and another unknown hectarage where rehabilitation has been partially completed).

Figure 28 illustrates the percent of proposed after uses for licensed pits in the ORM(GTA).

The number of licences (16) cancelled since 1984 in the ORM(GTA) has been only partially offset by three "new" licences issued since 1984.

From the APAO survey, it has been determined that of the 95 current licences, all but 12 were "grandparented" in under the Pits and Quarries Control Act.

From 1978 to 1991 there were:

* 48 wayside permits issued in the ORM(GTA) (32 municipal and 16 MTO)

* 3,454,690 tonnes of aggregates produced from wayside pits for road and highway projects.

This averages to 3.4 wayside permits per year with each wayside permit averaging a total of 72,000 tonnes.

Figure 26

Area of Licensed Pits and Disturbed Area in the Oak Ridges Moraine, GTA Portion

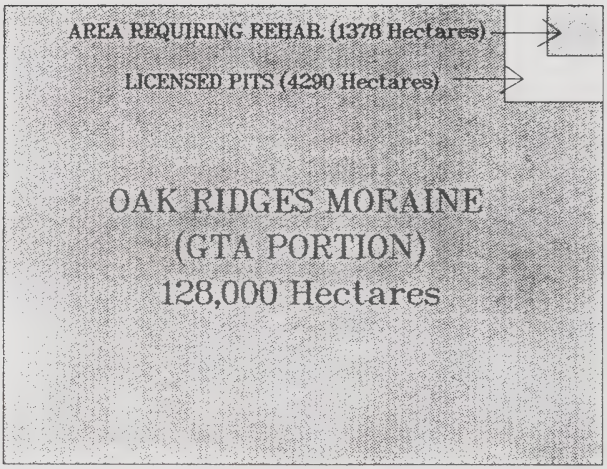
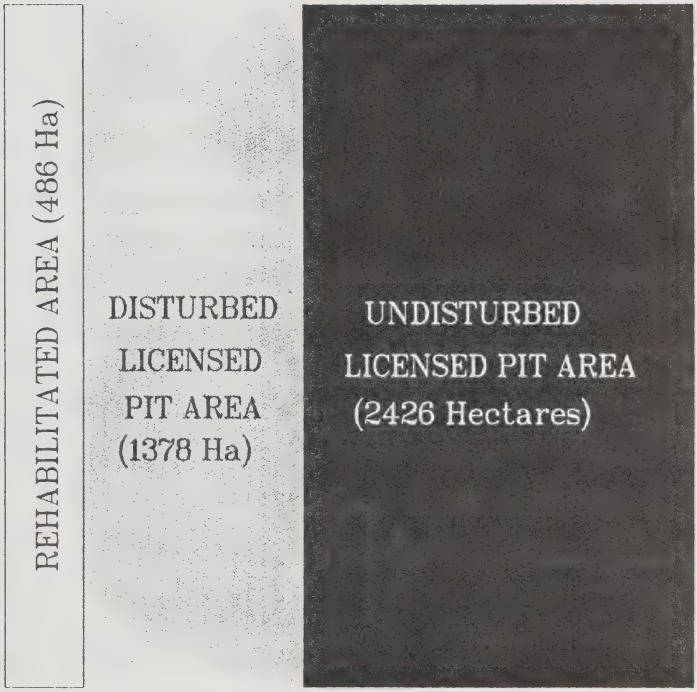


Figure 27

Disturbed Area Within Licensed Pits in the Oak Ridges Moraine, GTRA Portion

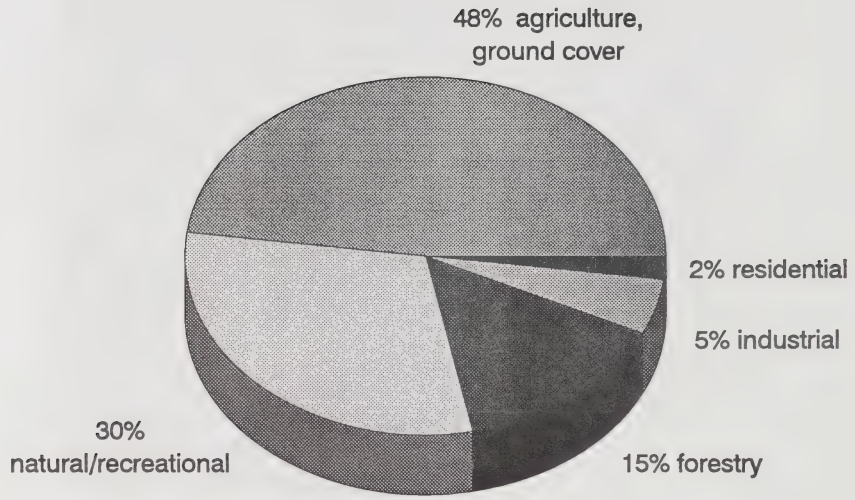


LICENSED PIT AREA = 4290 Hectares

Figure 28

Licensed Pits in the ORM(GTA)

Proposed After Uses



Wayside permits are characterized as being temporary in nature. Rehabilitation must be completed by the end of a wayside permit, whether for municipalities or MTO. A comprehensive review of rehabilitation from wayside permits was not done.

Rehabilitation of MTO wayside pits in the ORM must follow the requirements of the Aggregate Resources Act and MTO contract requirements more specifically:

* the site plan for a wayside permit on MTO contracts must include a detailed rehabilitation plan which is prepared according to provincial legislation, regulations and MTO contract requirements
* the permit, site plan requirements and MTO Special Provision 199S38 compel MTO contractors to carry out full rehabilitation.

Abandoned Pits and Quarries Rehabilitation Fund Program

The fund consists of:

* 1/2 cent per tonne collected from licenses and wayside permits
* $500,000-$800,000 per year accruing into the fund
* $50,000 contributed annually from the ORM(GTA)-based aggregate operations with an average annual production of 10 million tonnes.

Inventory work conducted in 1992 by MNR identified 208 abandoned pits. Figure 29 illustrates the location of abandoned pits in the ORM(GTA) based on a 1993 inventory carried out by MNR.

Pilot rehabilitation projects have been initiated. The first pilot project was the Rutherford Road Abandoned Pit Rehabilitation Project located in the Boyd Conservation Area in the City of Vaughan, along the Humber River. A description of this project is included in Appendix K. MNR and the APAO are establishing a list of priority sites for rehabilitation and, in association with the local municipalities and property owners, will be expanding upon the pilot projects.

Fill Importation

Some municipalities in the ORM are concerned about inadequate controls over the importation of excess materials into pits. The disposal of excess materials, primarily from construction, has become an issue because of the banning of certain materials at municipal landfills and stricter controls being imposed by MOEE on the re-use of certain excess materials such as blast furnace slag.

Pit excavations, by their nature, are preferred alternative sites to dispose of excess materials and the importation of excess materials to facilitate rehabilitation is frequently required.

Figure 29

Abandoned Pits in the Oak Ridges Moraine
Greater Toronto Area

Potential concerns of fill importation include:

* ensuring that material is inert (not contaminated)
* impacts on surface and subsurface water drainage
* increased truck traffic
* disposal of otherwise recyclable materials (see section 3.8).

MNR currently has limited control by ensuring adherence to:

* the final elevations (topography) for completed rehabilitation as shown on site plans
* sec. 23(a) of the Regulations which only allows material to be brought on-site for rehabilitation purposes when on-site material is insufficient.

MNR does not have the legislative mandate or the technical expertise to assure quality of these materials. MOEE regulates waste under the Environmental Protection Act. Currently, excess materials are either considered "inert fill" and can go to any willing receiver without MOEE involvement or the material is considered a regulated waste and must go into an approved site (i.e. municipal landfill).

MOEE in 1992 proposed a new policy for "Management of Excess Soil, Rock and Like Materials". The proposed policy would establish chemically-based fill categories, including a controlled fill category which would require a certificate of approval under the Environmental Protection Act. Following public review, the proposal is now being refined.

MTO Central Region is currently developing an interim policy guideline for the management of excess materials on its highway contracts.

Proposed Aquatic After Uses

Twenty-seven of 95 licenses in the ORM(GTA) are authorized to excavate below the water table which may result in a maximum of 426 hectares of lake/pond surface.

Of the planned 426 hectares for aquatic after use, 369 hectares (87 percent) are under licence to three companies: Standard Aggregates, Gormley Aggregates, and Vicdom Sand and Gravel.

4.4.4 Other Rehabilitation Techniques

Biological diversity has been defined by the Ontario Wildlife Working Group as "the variety of wild life species, the genetic variability of each species, and the variety of different ecosystems they form." In the past, few Ontario aggregate sites were deliberately rehabilitated to create a biologically diverse wildlife habitat. Typical rehabilitation strategies involved backfilling and uniform seedings.

However, observations of abandoned extraction sites in Ontario and elsewhere, as well as some rehabilitation designs specifically for wildlife from Britain and the United States, are demonstrating that aggregate extraction has an important role in maintaining a mix of landscapes, habitats and species. Rehabilitated extraction sites can provide the necessary habitats for unique plant and animal communities and may act as havens for rare or threatened species. In some cases, extraction has led to the expansion of a species' range, and the industry is one of the few that are creating new valuable wetland and cliff habitats.

In Britain, environmental groups have recognized this potential and will strongly support extraction projects that create good wildlife habitat as an end use. The Royal Society for the Protection of Birds has even published a practical manual entitled "Gravel Pit Restoration for Wildlife."

Appendix J contains other examples of former extraction sites in Ontario demonstrating high biodiversity, techniques to enhance biodiversity, and improvements to fisheries habitat with pits.

4.5 SUMMARY

1) Under the Mineral Aggregate Resources Policy Statement (MARPS), planning authorities must have regard for the availability of mineral aggregates.

2) The current Ontario legislative and regulatory framework provides for comprehensive assessment and mitigation of environmental impacts related to aggregate extraction.

3) The Aggregate Producers' Association of Ontario strives to promote the wise management of Ontario's aggregate resources while maintaining a healthy and competitive industry.

4) Use of new and improved technologies have enabled operators to significantly reduce environmental impacts (e.g. reduced water usage, dust suppression and noise abatement).

5) "Dewatering" (lowering of the water table) of sites is not undertaken in the extraction of aggregates in ORM. All aggregate washing operations in the ORM are reusing wash water in closed systems.

6) There is no water discharge from aggregate operations within the ORM; however, the MOEE's MISA program has confirmed that water discharges from aggregate operations elsewhere in Ontario are non-toxic.

7) Rehabilitation requirements ensure the "interim" nature or sequential type of land use of licensed or temporary wayside extraction, and can ensure the return of depleted areas to after-uses that are compatible with the long-term planning

objectives that result from the ORM planning study. Rehabilitation provides the opportunity to plan for after-uses that maximize biodiversity, wetland creation and natural areas.

8) Progressive rehabilitation requirements and a mandatory 4-year review of each pit licensed under the ARA, ensures a reduction of the "disturbed area" on existing and any new licensed sites, and provides an opportunity to incorporate progressive and innovative rehabilitation plans and after uses.

5.0 CONCLUSIONS

Aggregates are a basic and fundamental commodity required by the residents of the province. There is a clear need for this non-renewable resource to support the economic growth and stability of the Greater Toronto Area and its surrounding regions. However, the GTA produces only 60% of the aggregates that it consumes, despite the presence of considerable potential resources. These potential resources have become increasingly constrained due to planning pressures from competing land uses and, in some cases, past poor planning decisions, such that only limited amounts are readily available for licensing.

Current licensed reserves are inadequate to meet future demand without new reserves being added. Information from the APAO Operator Survey of ORM(GTA) licensees indicates that the current reserves of operators who responded (representing 99% of current production), compared with forecast demand, will be depleted within approximately 16 years. Annual demands for the GTA are projected to reach 87 million tonnes within the years 2006-2010. While existing reserves may be supplemented by proving out additional resources within licences, the outlook for aggregate availability in the ORM(GTA) remains a serious concern.

It is impractical to rely on development of potential resource areas outside the GTA. These areas have similar land use, environmental and social constraints which limit resource availability. Accessibility to aggregate resources in the surrounding areas can be no more assured than those within the GTA and the ORM(GTA). The shifting of the burden of production and increased licensing in these areas has already occurred partly due to restrictions in the GTA. There is no reason to believe that the residents of these areas are willing to bear an unfair share of this burden. The licensing of aggregate resources is a difficult, time consuming and expensive process, especially within the GTA.

The costs of transportation are borne by the consumers and taxpayers of the province. The additional costs of transportation from longer distances includes the economic costs and the substantial environmental cost of pollution along haul routes and the social impacts of more trucks past more people. The increased deterioration of the haul routes as more trucks travel more kilometres to deliver the same amount of aggregates will place increasing demands on the provincial government to fund road reconstruction and rehabilitation.

The Oak Ridges Moraine, and in particular the GTA portion of the moraine, contains a substantial amount of potential primary and secondary deposits of sand and gravel resources relative to other areas of the GTA or in the municipalities surrounding the GTA. Deposits of primary significance provide high quality aggregates for concrete and hot mix paving uses. Deposits of secondary significance can provide aggregates for lower quality uses in roads, highways and other construction projects. There is an adequate amount of potential resources that, if well managed in the context of land use planning and, in particular, during

the development of a planning strategy for the Oak Ridges Moraine (GTA), would provide the GTA with an adequate resource base to meet the increased demand for aggregate resources well into the future.

Many of the aggregate operations on the moraine have coexisted with their neighbours, despite their long history of extraction on the moraine. There have actually been few complaints about operations on the moraine. The regulatory controls of the Aggregate Resources Act and other legislation, combined with modern day operating procedures and mitigative techniques, are further assurances that this land use will have a minimal impact on the environment. These measures, and in particular compulsory progressive rehabilitation, will ensure that aggregate extraction remains a temporary land use and that the sites are returned to productive land uses following extraction.

Considerable on-going research, both in Ontario and further afield, is indicating that aggregate extraction sites provide increased opportunities for the regeneration of former degraded ecosystems. Pits undergoing progressive rehabilitation provide an opportunity for the enhancement of ecosystem biodiversity. This can come about by the generation of diverse landform features during rehabilitation.

The development of the planning strategy for the Oak Ridges Moraine provides a unique opportunity to balance the protection of the environment and the need for continued access to aggregates. Aggregate extraction has co-existed on the moraine for over 100 years and there is good reason, given modern day advances in extraction methodologies and the regulatory mechanisms now in place, that extraction should continue.

6.0 RECOMMENDATIONS

1) Any planning initiatives for the Oak Ridges Moraine must recognize the provincial significance of the sand and gravel resources in the moraine and their importance to the Greater Toronto Area and adjacent market areas.

2) The aggregate resources of the Oak Ridges Moraine must be considered as an integral part of a comprehensive and balanced planning approach to natural resource protection and economic development within the ORM. The non-renewable nature of this resource requires that equal consideration be given to aggregates compared with the other natural resources and features of the ORM.

3) Clear and reasonable planning application criteria should be developed to address specific environmental issues associated with the Oak Ridges Moraine. These criteria must be objective, attainable and balanced with the need for a continued aggregate supply.

4) Rehabilitation plans that enhance the natural environment and biodiversity of the Oak Ridges Moraine should be encouraged and promoted. Such an approach requires the cooperation of all levels of government and the aggregate industry if rehabilitation plans are to be appropriately developed in the context of the best after-use.

5) In accordance with MARPS, the location of primary and secondary aggregate deposits should be identified in planning documents and as much of this resource as is practicable should be protected from incompatible land uses in the development of an ORM planning strategy. Primary deposits are of particular importance. Half of the GTA's primary deposits are located in the ORM (13,099 of 26,310 hectares). Secondary deposits within the ORM(GTA) should receive improved protection from incompatible land uses since the majority of the GTA's secondary deposits are located in the ORM (44,360 of 53,755 hectares) and because of the depletion, sterilization or unavailability of primary deposits. In municipalities where primary deposits are limited, secondary deposits should be given more priority in the planning process.

6) In accordance with MARPS, existing licensed pits should be identified and protected from incompatible land uses. Further, opportunities for licence expansion into adjacent lands should be maximized in order to minimize the need to open other new areas.

7) In accordance with MARPS, criteria should be developed which allows for the establishment of wayside pits required for municipal road and provincial highway projects.

8) Aggregate related truck traffic is a major public concern and consideration should be given to the development and implementation of a strategy for planning future aggregate haul routes so that potential conflicts can be minimized along routes used to move aggregates.

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TECHNICAL APPENDICES TO THE OAK RIDGES MORAINE AGGREGATE RESOURCES STUDY

BACKGROUND STUDY NO. 10 TO THE
OAK RIDGES MORAINE AREA PLANNING STUDY

MAY 1994

APPENDIX A

TERMS OF REFERENCE FOR THE OAK RIDGES MORAINE AGGREGATE COMMITTEE

OAK RIDGES MORAINE PLANNING STUDY

AGGREGATES BACKGROUND STUDY 10: REVISED TERMS OF REFERENCE (93.04.06)

A STUDY OF AGGREGATE RESOURCES WITHIN THE OAK RIDGES MORAINE, GTA

EXECUTIVE SUMMARY

A HISTORICAL OVERVIEW OF AGGREGATES AND THE INDUSTRY

Industry Overview

* Definition of Aggregates and their general uses
* Industry (its history, its future)

Legislative/Land Use Planning Review

* Historical Review of Gov't Policy/Legislation on Aggregate Extraction
* Aggregate Resources Act together with reference to other legislation
* Land Use Planning (Planning Act, Mineral Aggregate Resources Policy Statement)
* Resolution of Conflicts between Provincial Policies
* Rehabilitation and legislative requirements (past versus present practices)

B AGGREGATE DEMAND/AGGREGATE INDUSTRY CHARACTERIZED

Aggregate Producer Questionnaire/Summary

* Uses (identify products, quantities produced and product mix)
* Quality of resource required for marketed products
* Market areas and mix of product to various market areas
* Production and distribution with respect to market areas
* No. of licenses held and relationship of ownership to associated companies
* Resources/reserves per licence
* Types of studies undertaken either to obtain or maintain licence, production or rehabilitation
* Annual production/licence and production limits (for the last 10 years)
* Operational aspects (re: water table, pumping, washing, screening, recycling, rehabilitation or other regulatory permits, etc.)
* particular operational or developmental constraints experienced
* Current haul routes from/through the ORM
* Variables affecting local and regional demand
* Lead time/costs experienced for licensing (e.g. from resources to reserves)

Demand for Aggregates

* Past, current and forecast production
* Statistics on licensed areas
* Licensing and production trends for the past 10 years
* Factors affecting industry competition (reasonable prices - MARPS)
  e.g. - concentration of ownership
  - number and size of operations
  - increased restrictions
  - cost of establishing new operations (capital, licensing etc.)

MTO Aggregate Requirements and Wayside Review

* Impact on Provincial/Municipal construction projects
* Environmental impact of wayside permits, relative to long term operations
* Resource conservation on Provincial/Municipal projects by recycling
* Aggregate Specifications

C SUPPLY ASPECTS OF AGGREGATE RESOURCES

* Definition of "ARIP Resources", "Potential Resources" versus "Reserves"
* Location of Potential Resource Areas (inside/outside ORM, GTA)
  - Primary and Secondary Sand and Gravel Deposits
  - Bedrock Resource Areas
* Location of current licences and past licences (cancelled)
* Additional mapping/exploration required to define distribution of resources
* Sustainability of Aggregate Resources

Constraints that impact on resource availability (2 Case Studies)

Town of Whitchurch/Stouffville and Manvers Township
* Preemptive (current) land uses
* Very Serious Constraints (including environmental and Provincially Significant resources (wetlands, ANSI's etc.)
* Serious Constraints (including agriculture, mature woodlots)
* Other land use interests or limitation not considered
* Estimated resources available for licensing consideration

D DISCUSSION OF SUPPLIES OUTSIDE OF THE OAK RIDGES MORAINE

Areas Outside the ORM, Currently Supplying the GTA

* Location/distribution
* Identify additional mapping/exploration needed
* Identify constraints to resource development in other areas

* Imports
* Sustainability

Long Distance Transportation (truck, rail, water)

* History
* Review options/opportunities/impacts
* Identify infrastructure requirements
* Re-evaluate potential and lead time to establish infrastructure

Underground (mining) Potential in the GTA

* History of its consideration
* Potential as a replacement
* Cost

Lower Great Lakes Sand Dredging

* History
* Potential as replacement
* Cost/environmental issues

E RESOURCE CONSERVATION

* Current consumption status (tonnes/capita/annum)
* Opportunities for reductions in use through:
    - construction design,
    - specification modification,
    - eliminate over-specification on design, and
    - education
* Additional opportunities/constraints for recycling
* Impact of potential supplies of recyclable materials for resource conservation

F ENVIRONMENTAL IMPACTS OF AGGREGATE EXTRACTION ON THE MORAINE

Identify Environmental Concerns of Aggregate Extraction

* Those addressed by legislation, (ARA, EPA, e.g. importation of fill, after use)
* Regulatory control of rehabilitation, enforcement
* Those not addressed by legislation, (e.g. haul routes, cumulative impact)

Evaluation of Environmental Issues/Concerns

* Hydrogeological issues/concerns

* Rehabilitation in the ORM (areas licensed, disturbed, rehabilitated)
* Discussion of level of impacts (major, minor or perceived)
* Identify mitigative techniques
* Discuss MISA monitoring program and its application to the aggregate industry

Identify Options to Address Concerns and Minimize Impacts

* Improved land use planning including Comprehensive Planning towards:
  - integrated after use/rehabilitation
  - avoidance of neighbouring land use conflicts
  - advanced haul route planning and protection
* Opportunities to integrate extraction with other land uses
  - open spaces
  - other land developments
* Proactive planning for extraction in areas of "Potential Resources" (a cradle to grave approach)
* Partnerships: Industry/Municipalities/Government/Public
* Criteria for Resource/Environmental Protection
* Identify methods and technological advances to minimize neighbourhood complaints (e.g. beyond legislative requirements)
* Improved techniques in rehabilitation and innovative uses for rehabilitated lands (reference to case studies)
* New technological advances applied to environmental protection
* Opportunities for improved education of industry and public

G OBSERVATIONS AND CONCLUSIONS

H RECOMMENDATIONS

I BIBLIOGRAPHY

APPENDIX
B

APAO OPERATOR QUESTIONNAIRE

Part 1. APAO Operator Survey

Part 2. APAO Operator Questionnaire Form

Part 3. Compilation of Responses

APAO OPERATOR QUESTIONNAIRE

Part 1. APAO Operator Survey

To assist the Oak Ridges Moraine Aggregate Committee (ORMAC) in compiling basic information and data on the aggregate industries within the Oak Ridges Moraine, the APAO prepared a comprehensive aggregate producers questionnaire (a sample of the questionnaire is included in Part 2, this Appendix B) to survey aggregate producers with operation on the ORM. This survey was undertaken by the APAO during 1992 and the survey:

* canvassed a total of 89 licence holders representing the 133 licensees in the ORM and including Class A (production limit > 20,000 tonnes per year) and Class B (production limit < 20,000 tonnes per year) ARA licence holders
* received responses from 59 of licensees within the ORM (GTA) and 7 responses from licensees with operations on the moraine but outside the GTA
* employed estimates compiled jointly by APAO, MNR and MTO of the twenty three operations for which there was no response to the questionnaire
* presents an amalgamation of data for multiple licences in the final tabulation of the questionnaire responses to preserve licensee confidentiality
* excluded the data compiled for the three licences on the Keele Street landfill site operated by Metro Toronto (these are fill materials and not marketed as aggregates).

The aggregate industry is highly competitive and operators are generally reluctant to part with information that may provide an economic advantage to their competitors. In order to gain the industry's confidence and to protect from the release of any sensitive company information, all information received from the questionnaires is treated confidentially. To protect this individual confidentiality only totals and amalgamated data may be used or released.

Wherever possible, all questionnaire information and data was cross referenced with other information sources, primarily that on file with the Ministry of Natural Resources and the Ministry of Transportation, to ensure accuracy.

Part 2. APAO Operator Questionnaire Form

The questionnaire is shown on the following three pages.

OAK RIDGES MORAINE
AGGREGATE RESOURCES STUDY
AGGREGATE PRODUCERS' QUESTIONNAIRE

CONFIDENTIALITY OF INFORMATION:

The Aggregate Producers' Association of Ontario, in conjunction with the Ministry of Natural Resources and the Ministry of Transportation, is undertaking a comprehensive study of aggregate resource development within the Oak Ridges Moraine study area (inside the boundary of the GTA). It is necessary for the aggregate industry to develop and present a strong position to counter anti-development and environmental preservation proponents. A critical aspect of that undertaking is an assessment of the supply component of aggregate resources. Your assistance through the completion of this questionnaire is essential.

ALL INFORMATION COLLECTED IN THIS SURVEY WILL BE STRICTLY CONFIDENTIAL and used in the final report in such a way that individual company data cannot be identified. The information will be available to APAO staff for compilation purposes only and will be destroyed at the completion of the study.

If you have any questions regarding this questionnaire or the use of reported data, please contact Michele Goulding or Rob Cook at the Association office (416) 507-0711.

- Please complete this section for each license or pit operation.
  Photocopy this form as required.

1. **RESPONDENT INFORMATION**

   Company Name _____.

   Contact Person _____.

   Date _____.

2. **LICENSE DESCRIPTION**

   Location: Lot _____.
   Concession _____.
   Township _____.
   Region _____.

   MNR License #(s) _____.

   Licensed hectares _____.

   Year of license issuance _____.

   Annual tonnage limit (if any) _____.

   Extraction approved below water table? _____.

   If yes: to what depth? _____.

   # of hectares to be water? _____.

3. RESOURCE AVAILABILITY

Hectare breakdown (within licensed boundary)

a) depleted _____%
b) proven reserves _____%
c) possible resource _____%
d) unavailable resources (setbacks, plant, conditions, etc.) _____%
e) rehabilitated _____%

Annual production (average over past 5 years) _____.

Estimated proven reserves _____ tonnes.

Is limestone depoted at this location? _____.

Do you wash materials? _____.

If yes, is all process water recycled? _____.

4. PRODUCT BREAKDOWN

Average percentage of total production (average over the past 5 years)

a) concrete & asphalt stone _____%
b) concrete & asphalt sand _____%
c) granular sub-base (B & sandfill) _____%
d) granular base (A & M) _____%
e) winter sand _____%
f) unmarketable byproduct _____%
g) other _____%

5. TRANSPORTATION

Average haul distance _____(km).

Average cost/tonne for delivery _____.

Main haulage routes _____

_____.

Are you restricted by half-load designations? _____.

6. REHABILITATION

Disturbed hectares awaiting rehabilitation _____.

Hectares rehabilitated _____.

Present use of rehabilitated lands _____

_____.

Nature of approved rehabilitation _____.

Final use of property if different from above _____

_____.

7. **GENERAL:**

License conditions restricting resource availability _____

_____

_____

_____.

Are you aware of any "old" rehabilitated site in your area?
(Location and name)

_____

_____

_____.

- HYDROGEOLOGY IS A PRIMARY CONCERN IN THE OAK RIDGES MORAINE. WE REQUEST ALL COMPANIES TO PROVIDE ANY SITE-SPECIFIC OR GENERAL REPORTS OR INFORMATION FOR INCORPORATION INTO OVERALL HYDROGEOLOGY STUDIES. INFORMATION IS ONLY BEING MAINTAINED IN THE ASSOCIATION OFFICE.

PLEASE RETURN QUESTIONNAIRES TO:

Michele Goulding
Administrative Manager
AGGREGATE PRODUCERS' ASSOCIATION OF ONTARIO
365 Brunel Road, Unit #2
Mississauga, Ontario
L4Z 1Z5

Part 3. Compilation of Responses

The results of the Operator Questionnaire are summarized in the following tables. In order to maintain the validity of the survey results the estimates generated by the ministries (MNR/MTO) and the APAO has been compiled separately. The data sets have been subdivided into three categories and each category further subdivided into two parts as follows:

* Category A: Operations in the ORM (GTA)
  - (i) Operator Responses (Table B-1)
  - (ii) MNR/MTO/APAO Estimates (Table B-2)

* Category B: Operations in the ORM excluding those in the GTA
  - (i) Operator Responses (Table B-3)
  - (ii) MNR/MTO/APAO Estimates (Table B-4)

* Category C: Operations in the ORM (Category A plus Category B)
  - (i) Operator Responses (Table B-5)
  - (ii) MNR/MTO/APAO Estimates (Table B-6)

The MNR/MTO/APAO Estimates were limited to compilation of the following:

* Licensed hectares
* Date operation started
* Date operation first licensed
* Annual tonnage limit
* Approvals to extract below the water table
* Depth of approved extraction
* Information on licensed resources (exclusive of proven reserves)
* Areas (hectares) rehabilitated or disturbed awaiting rehabilitation

There was insufficient information available on the individual licences to generate a reliable estimate of reserves. These data fields on the Tables are marked as "Not Available" or "N/A".

The total number of licences in each category, including questionnaire respondents and MNR/MTO/APAO Estimates, will not match the total number of licences (Table 17, Section 3.8.1) listed in the MNR records. Some of the respondents answers are based on a whole operation at a specific locality which may include more than one licence (e.g. adjacent licensed properties). The operator response was based on the whole operation and not each individual licence. This difference should not affect the validity of the data which has been presented as averages of the total of the individual responses.

The summaries of the responses are listed in the following tables.

Table B-1
APAO OPERATOR RESPONSES
ORM (GTA)

Total number of Licensed hectares		3,442.36
No. of Operations Started		
1920-1929	1	
1930-1939	0	
1940-1949	2	
1950-1959	12	
1960-1969	9	
1970-1979	14	
1980-1989	9	
1990-1992	2	
No. of Licences Issued		
1970-1974	47	
1975-1979	7	
1980-1984	2	
1985-1989	2	
1990-1992	1	
Total	59	
Total of Annual Tonnage Limit (if any)		20,523,450
No. of Companies Approved To:		
Extract below the water table		27
To a maximum depth of		20 Metres
To a minimum depth of		5 Metres
To an average depth of		11.22 Metres
Total # of hectares to be water		281.4
Licensed hectares:		
Depleted		27.11%
Proven Reserves		40.35%
Possible Resources		21.16%
No Resources		8.81%
Unavailable Resources		7.15%
Average Annual Production (tonnes) 1986 to 1991		8,838,807.87
Estimated Proven Reserves (tonnes)		158,844,530.00
No. of Companies that:		
Have a Limestone depot		10
Blend Limestone with on-site sand & gravel		9
Wash materials		4
Recycle all process water		4
Of the total amount of Annual Production:		
Concrete & Asphalt Stone		11.99%
Concrete & Asphalt Sand		21.56%
Granular Sub Base (B & Sandfill)		36.15%
Granular Base (A & M)		9.59%
Winter Sand		5.46%
Unmarketable Byproduct		3.36%
Other		11.90%
Percentage of Annual Production Shipped:		
Less than 10 km.		5.75%
10-24 km.		19.27%
25-49 km.		35.08%
50-74 km.		15.13%
75-100 km.		6.54%
More than 100 km.		1.53%
Disturbed hectares awaiting rehabilitation:		1054.17
Hectares already rehabilitated:		394.22

Table B-2
MNR/MTO ESTIMATES
ORM (GTA)

Total number of Licensed hectares		625.06
No. of Operations Started		
1920-1929	0	
1930-1939	0	
1940-1949	0	
1950-1959	3	
1960-1969	6	
1970-1979	1	
1980-1989	1	
1990-1992	0	
No. of Licences Issued		
1970-1974	16	
1975-1979	0	
1980-1984	1	
1985-1989	2	
1990-1992	0	
Total	19	
Total of Annual Tonnage Limit (if any)		4,738,400.00
No. of Companies Approved To:		
Extract below the water table		3
To a maximum depth of		5 Metres
To a minimum depth of		5 Metres
To an average depth of		5 Metres
Total # of hectares to be water		15
Licensed hectares:		
Depleted		49.48%
Proven Reserves		N/A
Possible Resources		25.34%
No Resources		1.81%
Unavailable Resources		3.24%

Average Annual Production (tonnes) 1986 to 1991		66,800
Estimated Proven Reserves (tonnes)		N/A
No. of Companies that:		
Have a Limestone depot	5	
Blend Limestone with on-site sand & gravel	0	
Wash materials	0	
Recycle all process water	0	
Of the total amount of Annual Production:		
Concrete & Asphalt Stone		0.00%
Concrete & Asphalt Sand		0.00%
Granular Sub Base (B & Sandfill)		9.36%
Granular Base (A & M)		7.86%
Winter Sand		0.00%
Unmarketable Byproduct		0.00%
Other		0.00%
Percentage of Annual Production Shipped:		
Less than 10 km.		0.00%
10-24 km.		0.75%
25-49 km.		0.75%
50-74 km.		0.00%
75-100 km.		0.00%
More than 100 km.		0.00%
Disturbed hectares awaiting rehabilitation:		211.5
Hectares already rehabilitated:		91.75

Table B-3
APAO OPERATOR RESPONSES
ORM OUTSIDE GTA

Total number of Licensed hectares		1,288.52
No. of Operations Started		
1920-1929	0	
1930-1939	0	
1940-1949	0	
1950-1959	1	
1960-1969	7	
1970-1979	6	
1980-1989	3	
1990-1992	0	
No. of Licences Issued		
1970-1974	12	
1975-1979	3	
1980-1984	1	
1985-1989	1	
1990-1992	0	
Total	17	
Total of Annual Tonnage Limit (if any)		10,638,000.00
No. of Companies Approved To:		
Extract below the water table		2
To a maximum depth of		12.19 Metres
To a minimum depth of		4 Metres
To an average depth of		9.46 Metres
Total # of hectares to be water		117.45
Licensed hectares:		
Depleted		10.26%
Proven Reserves		51.69%
Possible Resources		32.98%
No Resources		14.80%
Unavailable Resources		10.26%

Average Annual Production (tonnes) 1986 to 1991	4,939,924.08
Estimated Proven Reserves (tonnes)	406,930,000.00
No. of Companies that:	
Have a Limestone depot	2
Blend Limestone with on-site sand & gravel	1
Wash materials	3
Recycle all process water	3
Of the total amount of Annual Production:	
Concrete & Asphalt Stone	24.52%
Concrete & Asphalt Sand	23.34%
Granular Sub Base (B & Sandfill)	22.82%
Granular Base (A & M)	25.11%
Winter Sand	1.01%
Unmarketable Byproduct	0.94%
Other	0.40%
Percentage of Annual Production Shipped:	
Less than 10 km.	2.56%
10-24 km.	17.92%
25-49 km.	28.87%
50-74 km.	21.11%
75-100 km.	9.89%
More than 100 km.	11.56%
Disturbed hectares awaiting rehabilitation:	209.7
Hectares already rehabilitated:	34.5

Table B-4
MNR/MTO ESTIMATES
ORM OUTSIDE GTA

Total number of Licensed hectares		393.82
No. of Operations Started		
1920-1929	0	
1930-1939	0	
1940-1949	0	
1950-1959	0	
1960-1969	3	
1970-1979	1	
1980-1989	2	
1990-1992	0	
No. of Licences Issued		
1970-1974	4	
1975-1979	5	
1980-1984	3	
1985-1989	0	
1990-1992	0	
Total	12	
Total of Annual Tonnage Limit (if any)		2,761,000.00
No. of Companies Approved to:		
Extract below the water table		0
To a maximum depth of		0 Metres
To a minimum depth of		0 Metres
To an average depth of		0 Metres
Total # of hectares to be water		0
Licensed hectares:		
Depleted		2.73%
Proven Reserves		N/A
Possible Resources		4.82%
No Resources		0.00%
Unavailable Resources		0.25%

Average Annual Production (tonnes) 1986 to 1991	201,575
Estimated Proven Reserves (tonnes)	N/A
No. of Companies that:	
Have a Limestone depot	0
Blend Limestone with on-site sand & gravel	0
Wash materials	0
Recycle all process water	0
Of the total amount of Annual Production:	
Concrete & Asphalt Stone	0.00%
Concrete & Asphalt Sand	0.00%
Granular Sub Base (B & Sandfill)	0.00%
Granular Base (A & M)	0.00%
Winter Sand	0.00%
Unmarketable Byproduct	0.00%
Other	0.00%
Percentage of Annual Production Shipped:	
Less than 10 km.	0.00%
10-24 km.	0.00%
25-49 km.	0.00%
50-74 km.	0.00%
75-100 km.	0.00%
More than 100 km.	0.00%
Disturbed hectares awaiting rehabilitation:	24.79
Hectares already rehabilitated:	3

Table B-5
APAO OPERATOR RESPONSES
OAK RIDGES MORAINE
(COMBINED TABLE B-1 AND TABLE B-3)

Total number of Licensed hectares		4,730.88
No. of Operations Started		
1920-1929	1	
1930-1939	0	
1940-1949	2	
1950-1959	13	
1960-1969	16	
1970-1979	20	
1980-1989	12	
1990-1992	2	
No. of Licences Issued		
1970-1974	59	
1975-1979	10	
1980-1984	3	
1985-1989	3	
1990-1992	1	
Total	76	
Total of Annual Tonnage Limit (if any)		31,161,450.00
No. of Companies Approved To:		
Extract below the water table		29
To a maximum depth of		20 Metres
To a minimum depth of		4 Metres
To an average depth of		12.06 Metres
Total # of hectares to be water		398.85
Licensed hectares:		
Depleted:		22.52%
Proven Reserves:		43.44%
Possible Resources:		24.38%
No Resources:		10.44%
Unavailable Resources:		8.00%

Average Annual Production (tonnes) 1986-1991	13,778,731.95
Estimated Proven Reserves (tonnes)	565,774,530.00
No. of Companies that:	
Have a Limestone depot	12
Blend Limestone with on-site sand & gravel	10
Wash materials	7
Recycle all process water	7
Of the total amount of Annual Production:	
Concrete & Asphalt Stone	16.48%
Concrete & Asphalt Sand	22.20%
Granular Sub Base (B & Sandfill)	31.37%
Granular Base (A & M)	15.15%
Winter Sand	3.87%
Unmarketable Byproduct	2.49%
Other	7.78%
Percentage of Annual Production Shipped:	
Less than 10 km.	4.61%
10-24 km.	18.79%
25-49 km.	32.86%
50-74 km.	17.28%
75-100 km.	7.74%
More than 100 km.	5.12%
Disturbed hectares awaiting rehabilitation:	1263.87
Hectares already rehabilitated:	428.72
Number of surveys received:	89
Number of surveys requested:	132

Table B-6
MNR/MTO ESTIMATES
OAK RIDGES MORAINE
(COMBINED TABLE B-2 AND TABLE B-4)

Total number of Licensed hectares	1,018.88
No. of Operations Started	
1920-1929	0
1930-1939	0
1940-1949	0
1950-1959	3
1960-1969	9
1970-1979	2
1980-1989	3
1990-1992	0
No. of Licences Issued	
1970-1974	20
1975-1979	5
1980-1984	4
1985-1989	2
1990-1992	0
Total	31
Total of Annual Tonnage Limit (if any)	7,499,400.00
No. of Companies Approved To:	
Extract below the water table	3
To a maximum depth of	5 Metres
To a minimum depth of	5 Metres
To an average depth of	5 Metres
Total # of hectares to be water	15
Licensed hectares:	
Depleted	31.41%
Proven Reserves	N/A
Possible Resources	17.41%
No Resources	1.11%
Unavailable Resources	2.08%

Average Annual Production (tonnes) 1986 to 1991	268,375
Estimated Proven Reserves - Tonnes	N/A
No. of Companies that:	
Have a Limestone depot	5
Blend Limestone with on-site sand & gravel	0
Wash materials	0
Recycle all process water	0
Of the total amount of Annual Production:	
Concrete & Asphalt Stone	0.00%
Concrete & Asphalt Sand	0.00%
Granular Sub Base (B & Sandfill)	2.33%
Granular Base (A & M)	1.96%
Winter Sand	0.00%
Unmarketable Byproduct	0.00%
Other	0.00%
Percentage of Annual Production Shipped:	
Less than 10 km.	0.00%
10-24 km.	0.19%
25-49 km.	0.19%
50-74 km.	0.00%
75-100 km.	0.00%
More than 100 km.	0.00%
Disturbed hectares awaiting rehabilitation:	236.29
Hectares already rehabilitated:	94.75
Number of estimated surveys filled out by MNR/MTO:	35

APPENDIX C

MINISTRY OF TRANSPORTATION HIGHWAY CONSTRUCTION PROGRAM

Part 1. Highway/Road Design Standards

Part 2. Quality Requirements

Part 3. MTO Mandate and Strategic Priorities

Part 4. MTO Central Region

Part 5. Highway/Freeway Construction in the GTA

Part 6. The Planning Process for Highway 407

MINISTRY OF TRANSPORTATION HIGHWAY CONSTRUCTION PROGRAM

Part 1. Highway/Road Design Standards

Highways and roads must meet the requirements of the ever increasing user demand. Higher car traffic, but more importantly higher truck traffic demands more durable pavement structures and safer designs. Figure C-1 to C-4 show the aggregate quantity and quality aspects of the roadbed. The information has been excerpted from MTO Report MI-163, "Aggregate Quality and Quantity Requirements and Cost Considerations for Highway Construction in Ontario (1988-1991)".

Pavement Structure

The stress exerted on a pavement structure may be illustrated by a simplified wheel load distribution for a thin asphalt pavement as shown in Figure C-1. This diagram intends to demonstrate:

* that the highest quality aggregate is required close to the surface of the road due to the highest wheel load
* stress due to loading on individual aggregate particles is reduced with depth
* the quality requirements of aggregate material may be decreased with depth within the pavement structure.

This fundamental characteristic of pavement design allows a wide variety of aggregate quality and types to be used for road construction, depending upon service demand. In general, the conventional pavement structure is a combination of layers of:

* sub-base (normally Granular "B")
* base (normally Granular "A")
* a surface layer of bituminous hot mix, Portland cement concrete or surface treatment.

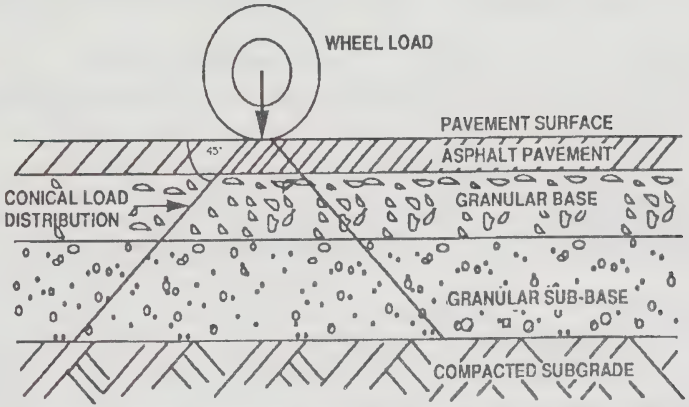
These layers are placed on a subgrade (usually native earth) to support and distribute the traffic load to the subgrade. Figures C-2, C-3, and C-4 present a graphic interpretation of different pavement structures with emphasis on type of aggregate required and extent of deterioration as a result of the use of poor quality aggregates.

The main types of aggregate used in road construction are as follows:

* Granular "A" is used for granular base (Table C-1)
* Granular "B" is used for granular sub-base (Table C-2)
* Granular "M" is mainly used for surface dressing of secondary roads and for shouldering
* Open Graded Drainage Layer (Figure C-3) is an important new component of expressway construction, and provides an effective method for rapid removal of water from the pavement structure into drainage ditches

Figure C-1

SIMPLIFIED WHEEL LOAD DISTRIBUTION FOR A
THIN ASPHALT PAVEMENT STRUCTURE



DEPTH mm	% OF WHEEL LOAD
50	100
200	12
280	8
410	4.5

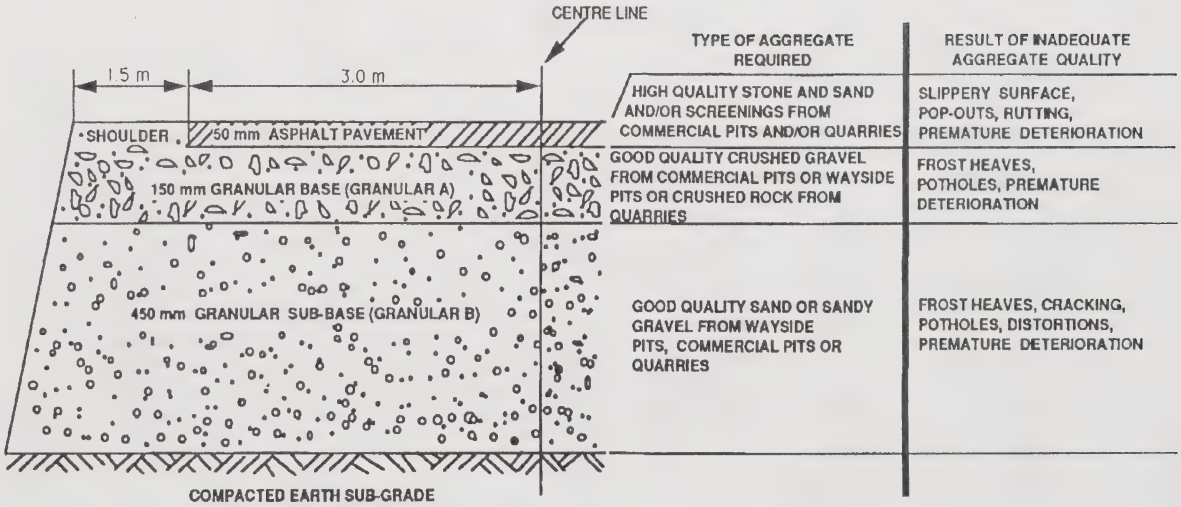
NOTE: GRANULAR BASE AND SUB-BASE CONSIST OF CRUSHED OR UNCRUSHED AGGREGATE.

OBSERVATIONS

1. LOAD IS DISTRIBUTED IN A CONICAL FASHION.
2. STRESS DUE TO WHEEL LOADING IS HIGHEST AT THE SURFACE, DECREASES WITH DEPTH.
3. HIGHEST QUALITY AGGREGATE IS REQUIRED CLOSE TO THE SURFACE, QUALITY MAY DECREASE WITH DEPTH.

Figure C-2

PAVEMENT STRUCTURE FOR A TYPICAL MUNICIPAL ROAD
(TWO LANES)

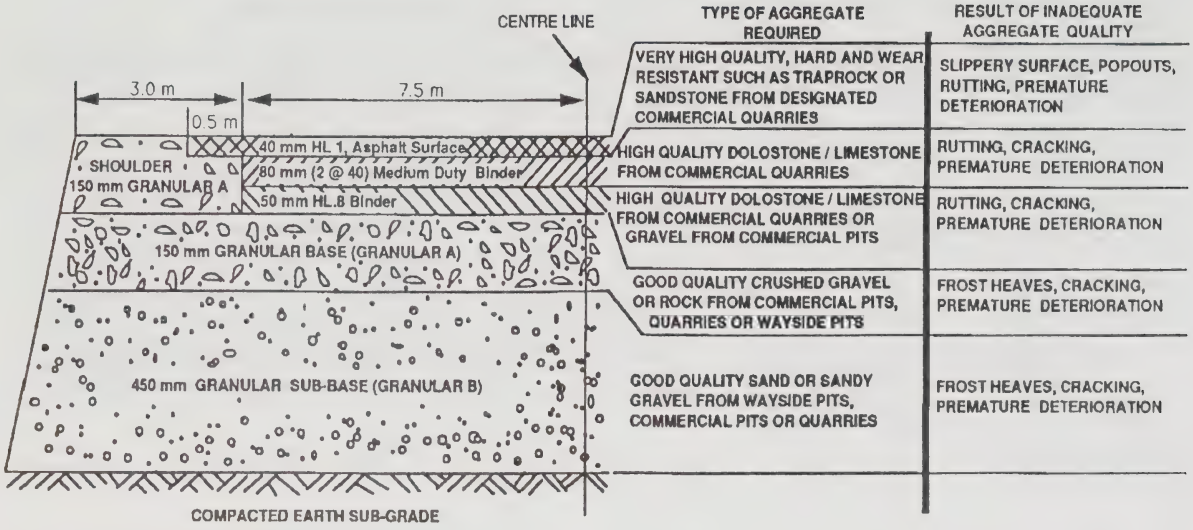


NOTE: NOT TO SCALE. ACTUAL PAVEMENT DESIGN DEPTH AND TYPE ARE LOCATION SPECIFIC BASED ON VARIOUS FACTORS.

EXAMPLES: HWYS. 47 & 50
REG RD. 23 LAKERIDGE ROAD DURHAM REGION
AIRPORT ROAD PEEL

Figure C-3

CONVENTIONAL PAVEMENT STRUCTURE FOR A REGIONAL/PROVINCIAL ROAD (FOUR LANES)

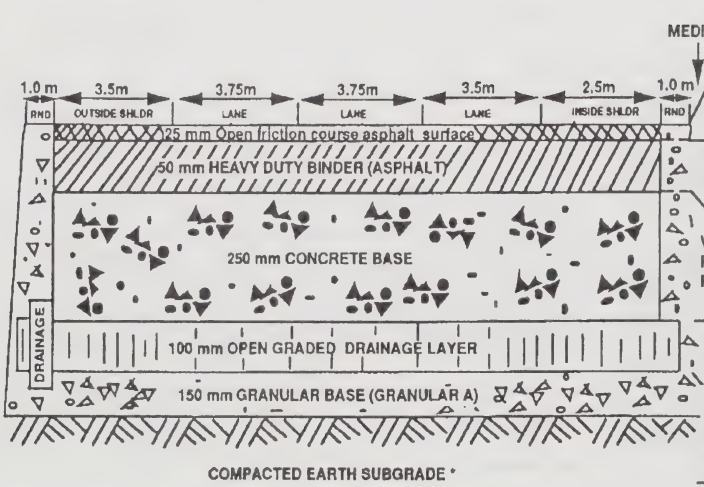


NOTE: NOT TO SCALE. ACTUAL PAVEMENT DESIGN DEPTH AND TYPE ARE LOCATION SPECIFIC BASED ON VARIOUS FACTORS.

EXAMPLES: HWYS. 11 & 7
KEELE STREET SOUTH OF KING
16TH AVENUE IN MARKHAM

Figure C-4

PAVEMENT STRUCTURE FOR A TYPICAL EXPRESSWAY
(SIX LANES)



TYPE OF AGGREGATE REQUIRED	RESULT OF INADEQUATE AGGREGATE QUALITY
VERY HIGH QUALITY, HARD AND WEAR RESISTANT SUCH AS TRAP-ROCK OR SANDSTONE FROM DESIGNATED COMMERCIAL QUARRIES	SLIPPERY SURFACE, POPOUTS, CRACKS, PREMATURE DETERIORATION
HIGH QUALITY DOLOSTONE / LIMESTONE FROM COMMERCIAL QUARRIES	RUTTING, CRACKING, BREAK UP, PREMATURE DETERIORATION
VERY HIGH QUALITY NON-ALKALI REACTIVE DOLOSTONE / LIMESTONE FROM COMMERCIAL QUARRIES	CRACKING, BREAK UP, STEPPING, PREMATURE DETERIORATION
HIGH QUALITY DOLOSTONE / LIMESTONE FROM COMMERCIAL QUARRIES	STEPPING, PREMATURE DETERIORATION
GOOD QUALITY CRUSHED GRAVEL OR ROCK FROM COMMERCIAL PITS/QUARRIES OR FROM WAYSIDE PITS	CONTAMINATION OF LAYERS ABOVE, PREMATURE DETERIORATION, FROST HEAVES

NOTE: NOT TO SCALE. ACTUAL PAVEMENT DESIGN DEPTH AND TYPE ARE LOCATION SPECIFIC BASED ON VARIOUS FACTORS.

EXAMPLES: HWYS. 404 & 407

* WHERE POOR SUBGRADE / DRAINAGE CONDITIONS EXIST, 200 mm TO 450 mm OF GRANULAR SUB-BASE (GRANULAR B) MAY ALSO BE REQUIRED.

* Hot mix asphalt or concrete materials provide the riding surface of the pavement structure and also act as the main structural bearing component close to the riding surface

Pavements are divided into flexible and rigid types. Flexible pavements include all bituminous surfaces placed over granular base. Rigid pavements have Portland cement concrete within the pavement structure. MTO uses two types of concrete pavement designs consisting of:

* plain or reinforced Portland cement concrete slabs which are placed either over a granular base, treated base or an Open Graded Drainage Layer
* composite pavements consisting of a plain concrete base overlaid by bituminous wearing courses (Figure C-4).

When compared with flexible pavements, the initial construction costs are higher for rigid pavements. However, rigid pavements provide greater load carrying capability, longer service life and reduced cost of maintenance.

Aggregate Quality Requirements

Specifying aggregate products in Ontario which are capable of performing equally well during hot summers and cold winters is a challenge. Expectancy of pavement surface life is limited to about twelve to sixteen years in Ontario. Physical requirements for aggregates are based on:

* type of use, type of test, and type of material, established by Ontario Provincial Standard Specifications (MTO, 1977) and MTO Special Provisions (MTO, 1983)
* Aggregate Research and Development that has been occurring for over 40 years (data to this effect is summarized in Tables C-1 and C-2)
* satisfactory field performance, which remains the most desired test of all and ultimately determines whether or not a specific aggregate type was or will be suitable for the intended engineering purpose.

Figures C-2, C-3 and C-4 show the type of aggregates required for designated use and the resulting distresses and deterioration if inadequate quality aggregates are used.

Table C-1

PHYSICAL REQUIREMENTS FOR AGGREGATES

ONTARIO PROVINCIAL STANDARD SPECIFICATIONS AND MTO SPECIAL PROVISIONS

COARSE AGGREGATES	TYPE OF TEST / TYPE OF USE	Petro. No. (Max)	$MgSO_4$ Soundness (Max % Loss)	Absorp. (Max %)	Los Angeles Abr. (Max %)	Percent Crushed (Min %)	Flat and Elong. Pieces (Max %)	Loss by Washing pass 75µm Gravel (Max %)	Loss by Washing pass 75µm Quarr'd Rock (Max %)	Two Face Crushed (Min %)	Plasticity Index	Freeze/Thaw (Max % Loss)	TYPE OF MATERIAL
	Granular A	200			60	50					0		Cr. Rock, Cr. Gravel, Bl. Furn. and Ni. Slag
	Granular M	200			60	50					0		As Above
	Granular S	200			60	50					0		Cr. Rock or Cr. Gravel
	Granular Subbase Type 1	250									0		Sand, Gravel, Cr. Rock, Bl. Furn. and Ni. Slag
	Type 2	250			60	100					0		Crushed Rock Only
	Select Subgrade Material	250									0		Sand or Gravel, Cr. Rock
	Open Graded Drainage Layer(1)	160	15	2.0	35	100	20	1.3	2.0		0		Crushed Rock
	Hot Mix-H.L. 1, DFC, OFC	See OPSS 1149 and Special Provision No. 313S10											Trap Rock, Dolomitic Sandstone, Meta-Arkose, High Quality Gravel
	Hot Mix-H.L. 3	135	12	1.75	35	60	20	1.3	2.0				Cr. Rock or Cr. Gravel
	H.L. 4 (Surface)	160	12	2.0	35	60	20	1.3	2.0				As Above
	H.L. 4 & 8 (Binder)	160	15	2.0	35	60	20	1.3	2.0				As Above
	Medium Duty Binder	160	15	2.0	35	95	20	1.3	2.0	80			As Above
	Heavy Duty Binder	160	15	2.0	35	100	20	1.3	2.0				Crushed Rock
	Surface Treatment(1) Class 1 & 5	135	12	1.75	35	60	20						Cr. Rock or Cr. Gravel
	Class 2	160	15		35	60	20						As Above
	Class 3	160	12	2.00	35	60	20						As Above
	Structural Concrete and Concrete Base	140	12	2.0	50		20	1.0	2.0				Cr. Rock or Cr. Gravel. Cr. Rock is Necessary for High Strength, Must be Chemically Stable (Not Reactive)
	Pavement Concrete and Exposed Structure Deck	125	12	2.0	35		20	1.0	2.0				As Above

(1) Hot mix and concrete petrographic number applies

Table C-2
PHYSICAL REQUIREMENTS FOR AGGREGATES
ONTARIO PROVINCIAL STANDARD SPECIFICATIONS AND MTO SPECIAL PROVISIONS

FINE AGGREGATES	TYPE OF TEST / TYPE OF USE	$MgSO_4$ Soundness (Max % Loss)	Petro. Analysis (2)	Organic Impurit. (Max)	Sand Attrit'n (Max % Loss)	Micro-Deval Abr. (3) (Max % Loss)	Pass 75µm	Plastic Index	TYPE OF MATERIAL
	Hot Mix - H.L. 1	16	(2)			20	0-5	0	Natural Sand, Gravel or Crushed Rock Screenings
	H.L. 2	20				25	3-8	0	As Above
	H.L. 3	16				20	0-5	0	As Above
	H.L. 4 (Surface)	20				20	0-7	0	As Above
	H.L. 4 & 8 (Binder)	20				25	0-7	0	As Above
	Medium Duty Binder	20	(2)			25	0-7	0	As Above
	Heavy Duty Binder	20	(2)			25	0-5	0	Crushed Rock Only
	O.F.C.		(2)			20	0-3	0	High Quality Gravel, Dolomitic Sandstone, Trap Rock
	D.F.C.	20	(2)			20	2-5	0	Dolomitic Sandstone, Trap Rock, Meta-Arkose
	Surface Treatment Class 4	20					0-7	0	Natural Gravel or Crushed Rock Screenings
	Structural Concrete and Concrete Base	16	(2)	3	(2)	20	0-3		Natural Sand
							0-5		Manufactured Sand
	Pavement Concrete and Exposed Structure Deck	16	(2)	3	(2)	20	0-3		Natural Sand
							0-5		Manufactured Sand
	Ice Control Sand				9		0-5		Natural Sand
					14		0-3		Manufactured Sand

(2) Test results are analyzed for specific contracts, but there are no current specification limits
(3) Replacing $MgSO_4$ Soundness as of 1992 on MTO contracts only

Aggregate Quantity Requirements for Highways and Roads

Table C-3 complements Figures C-2, C-3 and C-4 by providing data on aggregate quantity requirements when one kilometre of a typical two-, four- or six-lane highway is constructed. It must be stressed that actual aggregate requirements are a function of specific pavement design, which is a function of traffic volume and local geological/soil conditions. On average, aggregate requirements for the construction of one kilometre of highway are:

* two-lane highway - 15,400 tonnes
* four-lane highway - 40,600 tonnes
* six-lane highways - 51,800 tonnes.

Often soft or wet subgrade conditions can elevate these figures substantially.

By product type, aggregate quantities used on MTO contracts show some fluctuation on a regional basis. Central Region has used about 2 million tonnes of aggregate yearly. For construction, the largest volume of aggregate products include Granular "A", Granular "B", Hot Mix asphalt aggregate, Select Subgrade Material, and Portland cement concrete aggregate. For maintenance work, Winter Sand is a major product with an average MTO consumption of 0.9 million tonnes annually.

Part 2. Quality Requirements

Over the years aggregate quality requirements, particularly for highways, have become more stringent. Engineering and construction innovations in high rise buildings such as the Scotia Tower and Sky Dome require high strength concrete with increased aggregate strength and durability requirements.

The Ministry of Transportation, Ontario municipalities and the construction industry use the Ontario Provincial Standards Specifications (O.P.S.S.) which establish the specifications or quality standards for aggregate products.

Some of the quality requirements for aggregate products as established in the O.P.S. Specifications include:

* **Absorption**: determines the ability to withstand weathering & durability
* **Petrographic composition**: This determines the physical properties and mineral composition of aggregate.
* **Strength and hardness**: The aggregate must be resistant to physical breakdown especially in terms of freeze-thaw activity and abrasion.
* **Chemical reactivity**: Aggregate must be resistant to chemical alteration that results in changes to the physical character of construction materials.
* **Grain Size**: Most aggregate products must be crushed, screened or washed to produce appropriate gradation and particle sizes.
* **Particle shape**: Different shapes are required for various materials. Rough cubic shapes are preferred in high strength applications whereas rounded aggregate particles are utilized to produce smooth surfaces.

Table C-3

TYPICAL AGGREGATE QUANTITY REQUIREMENTS FOR ONE KILOMETRE OF HIGHWAY CONSTRUCTION

TYPE OF PAVEMENT STRUCTURE (AGGREGATE PRODUCT)	QUANTITY (TONNES)
TYPICAL MUNICIPAL ROAD, TWO LANES (Figure C-2)	
50mm ASPHALT PAVEMENT* (H.L. 3 OR H.L. 4)	700
50mm SHOULDER (GRANULAR A OR GRANULAR M)	350
150mm GRANULAR BASE (GRANULAR A)	3,850
450mm GRANULAR SUB-BASE (GRANULAR B)	10,500
TOTAL	**15,400**
* May be replaced with surface treatment in some low traffic volume roads. If traffic is high, additional hot mix will be required.	
TYPICAL REG./PROV. ROAD, FOUR LANES (Figure C-3)	
40mm ASPHALT SURFACE (H.L. 1)	1,600
80mm ASPHALT BINDER (MEDIUM DUTY BINDER)	2,800
50mm ASPHALT BINDER (H.L. 8 BINDER)	1,700
150mm SHOULDER (GRANULAR A)	5,800
150mm GRANULAR BASE (GRANULAR A)	5,400
450mm GRANULAR SUB-BASE (GRANULAR B)	23,300
TOTAL	**40,600**
EXPRESSWAY, SIX LANES (Figure C-4)	
25mm ASPHALT SURFACE (OPEN FRICTION COURSE)	1,900
50mm ASPHALT BINDER (HEAVY DUTY BINDER)	4,000
250mm CONCRETE BASE (CONCRETE)	14,700
100mm DRAINAGE LAYER (OPEN GRADED DRAINAGE LAYER)	5,400
150mm+ GRANULAR BASE (GRANULAR A, INCLUDES CROSSFALL ALLOWANCE)	25,800
TOTAL	**51,800**
200mm to 450mm GRANULAR SUB-BASE** (GRANULAR B)	EXTRA: 13,600 - 30,600
TOTAL WITH EXTRA	**65,400 - 82,400**
** where poor subgrade/drainage conditions exist	

Part 3. MTO Mandate and Strategic Priorities

The Ministry mandate is to:

* provide the focal point for the identification of the transportation needs of the people of Ontario
* be the provincial leader in cost effective transportation supporting the province's broader economic, social and environmental objectives
* work with other jurisdictions and groups to address these needs through the effective use of road, rail, transit, air and marine transportation systems and services in accordance with the prevailing objectives of the Province of Ontario.

The Ministry's strategic priorities are:

* economic renewal and competitiveness
* safety in transportation
* equity in transportation
* environmental sustainability of transportation.

These strategic priorities are delivered through the Ministry's highway design, construction and maintenance programs that have the following:

* A role to continue as the primary deliverer of transportation programs, products and services to the people of Ontario
* A mission to provide and maintain, in an economical and environmentally sensitive manner, safe transportation facilities and services according to the Ministry Mandate
* Responsibility for establishing transportation engineering and service standards, operational policies and monitoring performance
* Promoting quality transportation facilities and services through innovative research and acquisition processes

Part 4. MTO Central Region

The MTO's Central Region (Figure 2, Chapter 2) includes:

* Metropolitan Toronto
* Regional Municipalities of Durham, Halton, Hamilton-Wentworth, Niagara, Peel and the east part of Haldimand-Norfolk
* Counties of Brant, Northumberland, Victoria and the east part of Simcoe.

The Region encompasses:

* a land area that measures over 20,000 square kilometres (less than 2 percent of Ontario by area)

* a population exceeding 5,000,000 people or more than 55 percent of the province's total population.

Part 5. Highway/Freeway Construction in the GTA

From a provincial transportation viewpoint, the following subsections briefly describe upcoming provincial roadwork in the GTA. For ease of presentation, the roadwork is categorized under highways and freeways.

GTA HIGHWAYS

Highway 2	-	Upgrading, Town of Newcastle (10 km)
Highway 7	-	Widening, Brampton to Georgetown (10 km)
	-	Upgrading, Manilla to Sunderland (7 km)
Highway 7N	-	Widening, Town of Vaughan (6 km)
Highway 9	-	Upgrading, Weston Rd. to Hwy. 50 (22 km)
Highway 10	-	Widening, Town of Caledon (11 km)
Highway 11	-	Upgrading, Richmond Hill to Holland Landing (17km)
Highway 12	-	Widening, Town of Whitby (2 km)
	-	Upgrading, Whitby to Sunderland (31 km)
	-	Widening, South junction Hwy. 48 to north junction Hwy. 48 (13 km)
Highway 27	-	Upgrading, Nobleton to Hwy. 9 (12 km)
Highway 47	-	Upgrading, Greenbank to Uxbridge (9 km)
Highway 50	-	Widening, Hwy. 7 to Bolton (14 km)
	-	Upgrading, Bolton to Hwy. 9 (15 km)
Highway 136	-	Upgrading, Hwy. 24 to Orangeville (12 km)

GTA FREEWAYS

Highway 400	-	New Interchange, Rutherford Rd.
	-	Upgrade Interchange, Major MacKenzie Dr.
	-	Widening, Hwy. 401 to Steeles Ave. (6 km)
	-	Widening, Hwy. 7 to Major MacKenzie Dr. (8.5 km)
Highway 401	-	Upgrade Interchange, Hwy. 10
	-	Widening, City of Mississauga (7 km)
	-	Widening, Neilson Rd. to Brock Rd. (15 km)
	-	Widening, Hwy. 25 to Cambridge west limits (13 km)
Highway 403	-	New Freeway, Hwy. 403/QEW to Hwy. 5 (5 km)
Highway 404	-	Widening, Hwy. 410 to Major MacKenzie Dr. (13 km)
Highway 427	-	Upgrading, Hwy. 5 to Hwy. 401 (5 km)
	-	Widening, Hwy. 401 to Hwy. 7 (9 km)
QEW	-	New Interchange, Guelph Line
	-	Upgrading, Oakville to Etobicoke (20 km)

Part 6. The Planning Process for Highway 407

The Need:

* Recognized as early as the 1950's
* To relieve congestion on Highways 7 and 401
* To relieve congestion on arterial roads
* To accommodate future traffic increases
* To provide improvement in safety

The Route:

* Engineering studies commenced in the mid 1960's
* A "Parkway Belt" (multiple use corridor) from Hamilton to Markham was studied
* Cabinet approved the "Parkway Belt West Development Plan" in 1978
* Land was protected for future transportation purposes from Highway 403 to Highway 48 (Figure C-5)
* A route planning study is currently in progress to determine location and right-of-way requirements from Highway 48 to Highway 35/115 (Figure C-6)
* Similar route planning studies are also in progress for two freeway links between Highway 401 and the proposed Highway 407. These include:
  - Pickering/Ajax/Whitby Freeway Link (10 km) (Figure C-7)
  - Oshawa/Newcastle Freeway Link (10 - 17 km) (Figure C-8).

The Cost:

*	Highway 403 to Airport Road	$ 775 Million
*	Airport Road to Highway 48	$1,225 Million
*	Highway 48 to Highway 35/115	$1,100 Million
	Total Capital Costs 1992	**$3,100 Million**

Figure C-5

Highway 407 Planned Route from Highway 403 to Highway 48

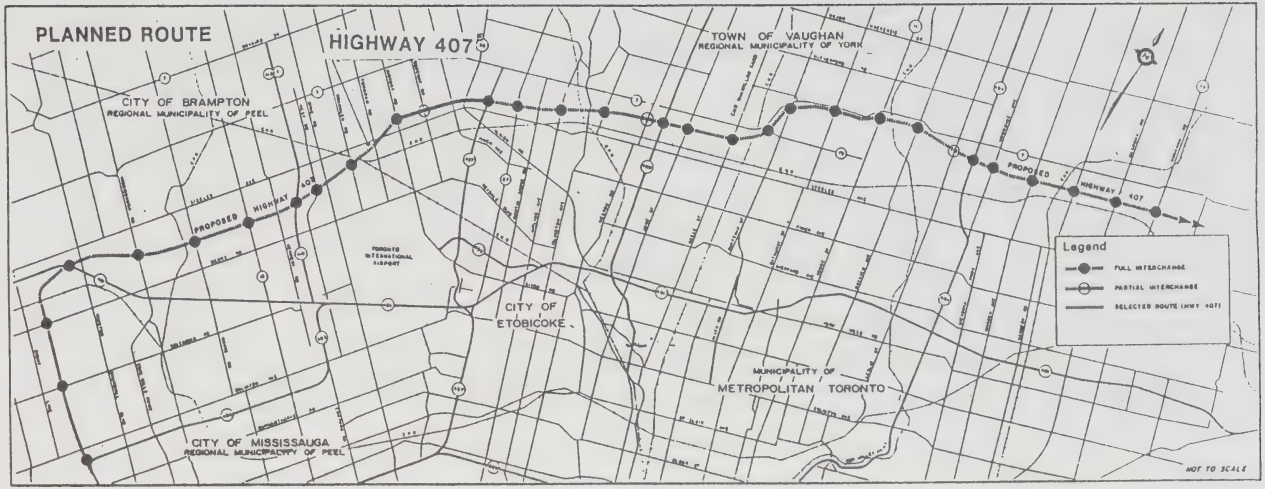


Figure C-6

Highway 407 Route Planning from Highway 48 to Highway 135/115

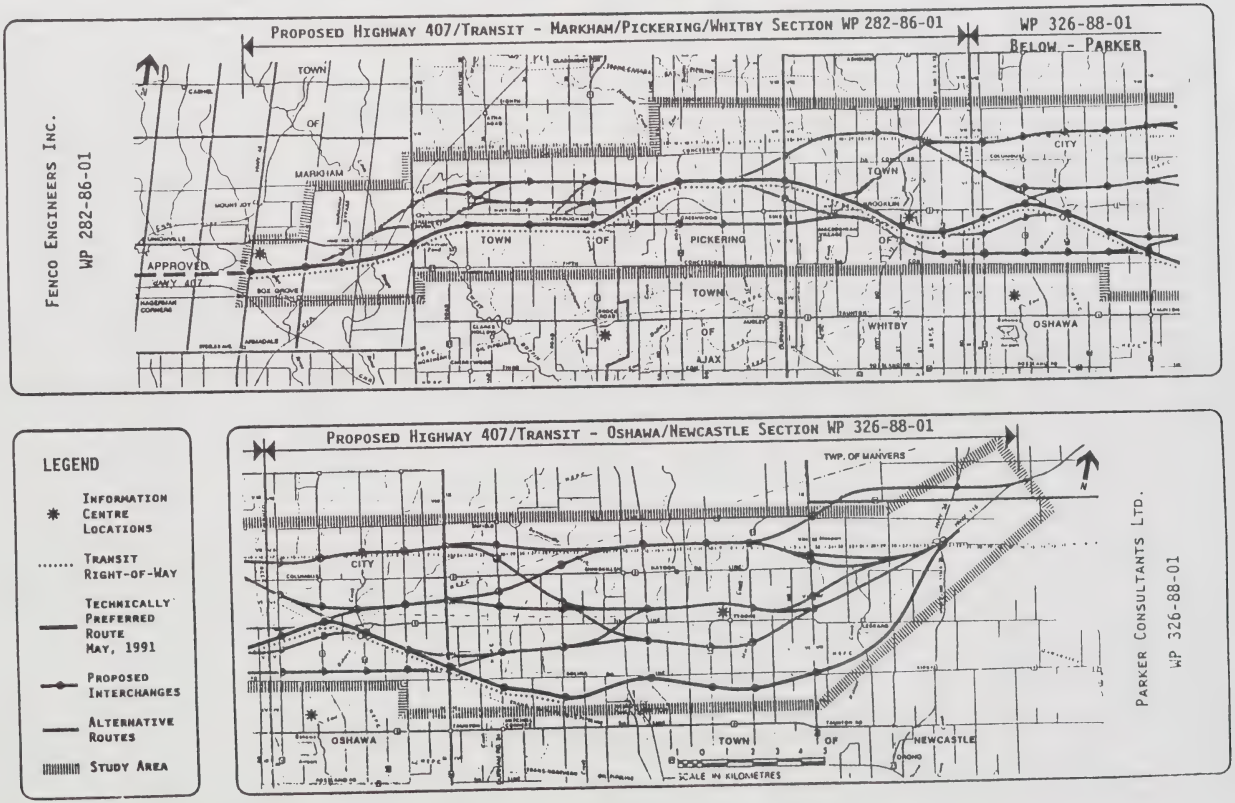


Figure C-7

Route Planning Study for the Proposed Pickering/Ajax/Whitby Freeway Link Between Highway 401 and Highway 407

1. INTRODUCTION

The Ministry of Transportation (MTO) is conducting a study to determine the location and right-of-way requirements for the proposed Pickering/Ajax/Whitby Freeway Link from Highway 401 northerly to the proposed Highway 407 for a distance of approximately 10 km.

This is the third in a series of brochures advising the public of the study's progress. It is also an invitation to attend the second set of Public Information Centres to be held on February 25, and 27, 1992.

2. STUDY PROGRESS

The study began in the early fall of 1990 and the results of the initial data collection phase, along with the preliminary identified alternative routes, were reviewed during a series of presentations, meetings and Public Information Centres in November 1990. Since then a detailed analysis and evaluation has been carried out and the technically preferred route has been identified based on assessments of environmental and engineering data, discussions with governmental agencies and local municipalities, and information received from the public.

3. ANALYSIS AND EVALUATION

The technically preferred route and the alternatives considered are shown to the right. The alternative routes have been analyzed and evaluated to determine their advantages and disadvantages, based on the effects each would have on the following:

- Natural Environment
- Social Environment
- Economic Environment
- Cultural Environment
- Agricultural Environment
- Transportation and Engineering

Displays showing the analysis and evaluation process and the technically preferred route will be available for review and discussion at the Public Information Centres. The identification of the technically preferred route has taken into account both the analysis and the views expressed by the public, municipal staff and government agencies during the first round of public review.

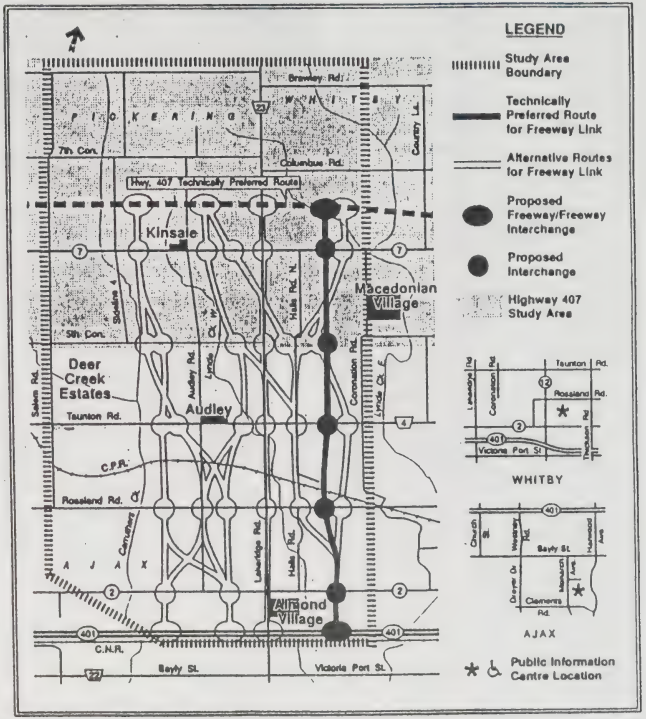


Figure C-8

Route Planning Study for the Proposed Oshawa/Newcastle Freeway Link Between Highway 401 and Highway 407

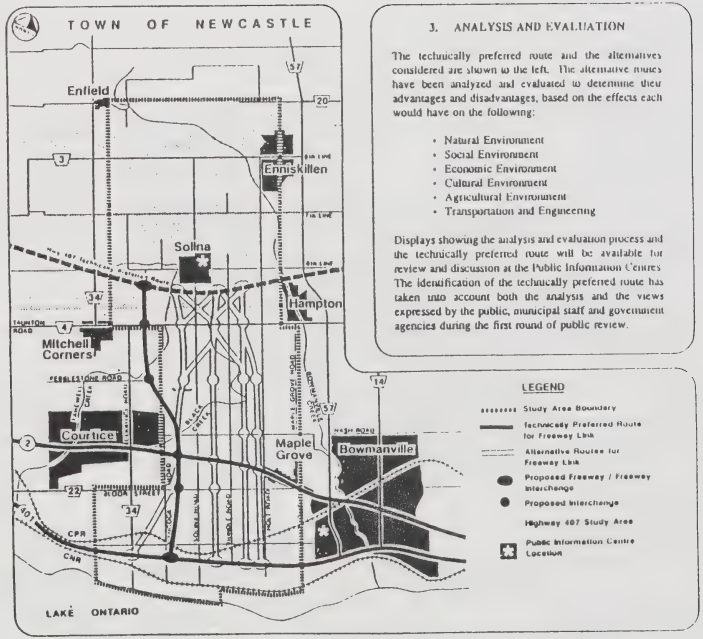
1. INTRODUCTION

The Ministry of Transportation (MTO) is conducting a study to determine the location and right-of-way requirements for the proposed Oshawa/Newcastle Freeway Link from Highway 401 northerly to the proposed Highway 407 for a distance of approximately 10 kilometres.

This is the third in a series of brochures advising the public of the study's progress. It is also an invitation to attend the second set of Public Information Centres to be held on February 18 and 19, 1992.

2. STUDY PROGRESS

The study began in the early fall of 1990 and the results of the initial data collection phase, along with the preliminary identified alternative routes, were reviewed during a series of presentations, meetings and Public Information Centres in November 1990. Since then, a detailed analysis and evaluation had been carried out, and the technically preferred route has been identified based on assessments of environmental and engineering data, discussions with government agencies and local municipalities, and information received from the public.



3. ANALYSIS AND EVALUATION

The technically preferred route and the alternatives considered are shown to the left. The alternative routes have been analyzed and evaluated to determine their advantages and disadvantages, based on the effects each would have on the following:

- Natural Environment
- Social Environment
- Economic Environment
- Cultural Environment
- Agricultural Environment
- Transportation and Engineering

Displays showing the analysis and evaluation process and the technically preferred route will be available for review and discussion at the Public Information Centres. The identification of the technically preferred route has taken into account both the analysis and the views expressed by the public, municipal staff and government agencies during the first round of public review.

APPENDIX
D

POTENTIAL AGGREGATE RESOURCE AREAS

Part 1. **Description of Maps in Aggregate Resources Inventory Papers (ARIPs)**

Part 2. **Digital Aggregate Resource Mapping Within the Study Area**

POTENTIAL AGGREGATE RESOURCE AREAS

Part 1. Description of Maps in Aggregate Resources Inventory Papers (ARIPs)

ARIP Map 1

Map 1 provides information on the location of all known sand and gravel deposits, buried gravel or sand, and other surficial deposits. It also identifies the sources of the mapped information and includes symbology to demonstrate the results of analyses of samples collected at various sites, including:

* a texture symbol (a quantitative assessment of grain size distribution at a sampled location)
* an estimate of the gravel content symbol (G(gravel): >35 percent gravel; S(sand): <35 percent gravel)
* a thickness class symbol (1: >6m; 2:3-6m; 3:1.5-3m; 4: <1.5m)
* the geological type (geological origin) of the sampled material
* a quality indicator describing the presence of:
  - objectionable grain sizes (i.e. too much silt or clay)
  - deleterious lithologies
  - unacceptable quantities of oversize particles.

This map has been discontinued from more recent ARIP publications.

ARIP Map 2

Map 2 provides a summary of the potential for locating the following classification of selected sand and gravel resource areas:

* primary significance
* secondary significance
* tertiary significance
* location of sand and gravel pits and licensed pits at the time of mapping and publication

ARIP Map 3

Map 3 identifies the:

* distribution of bedrock units (including rock type and formation names)
* drift thickness (i.e. Palaeozoic bedrock covered by varying depths of drift (<1m, 1 to 8m, 8 to 15m, >15m)
* undifferentiated Precambrian bedrock covered by thin drift
* location of quarries and licensed quarries at the time of mapping and publication.

Part 2. Digital Aggregate Resource Mapping Within the Study Area

Nineteen percent of the Study Area (i.e., some of the outermost parts) does not have digital aggregate resource mapping available. These areas are excluded from calculations of potential resource availability. Table D-1 details the excluded areas.

MNR data on file at the MNR District Offices has been compiled to supplement ARIP data where no ARIP coverage was available. This includes data within the following municipalities:

- Ajax
- Aurora
- Belmont
- Brampton
- Brighton
- Cramahe
- Harvey
- Metropolitan Toronto
- Murray
- Newmarket
- Nottawasaga
- Oakville
- Onondaga
- Pickering
- Percy
- Richmond Hill
- Seymour
- Streetsville
- Vaughan

In some of these Municipalities it is known that there are no further resources available or that the remaining resources have been sterilized by development (e.g., Brampton & Metropolitan Toronto).

Table D-1

Portions of the Study Area Where Digital Mapping is Unavailaible

County/ Regional Municipality	Geographic Township	Area (ha)	Percent of County/ Region
Dufferin		149,019	
	East Luther **(subtotal)**	**16,073**	**10.8 %**
Northumberland		209,325	
	Percy	21,797	
	Cramahe	19,767	
	Murray	21,176	
	Seymour	28,539	
	Subtotal (excluded)	**91,279**	**43.6 %**
Peterborough		394,256	
	Galway & Cavendish*	47,878	
	Chandos*	22,792	
	Burleigh & Anstruther*	61,144	
	Harvey	40, 202	
	Belmont & Methuen	56,354	
	Asphodel*	15,877	
	Subtotal (excluded)	**173,577**	**44.0 %**
Simcoe		480,000	
	Rama**	16,692	
	Mara**	25,708	
	Subtotal (excluded)	**42,400**	**8.8 %**
Victoria		306,690	
	Dalton*	16,654	
	Laxton, Digby & Longford*	46,850	
	Subtotal (excluded)	**63,504**	**20.7 %**
Waterloo	*	134,270	
	Wellesley	27,160	
	Woolwich	31,898	
	Subtotal (excluded)	**59,058**	**44.0 %**
Wellington		265,931	
	Maryborough	23,061	
	Minto	28,970	
	Arthur	27,016	
	West Luther	20,577	
	Subtotal (excluded)	**99,624**	**37.5 %**

* ARIP coverage available but not digitized
** Preliminary data available but not digitized

APPENDIX
E

CONSTRAINTS ON AGGREGATE RESOURCE DEVELOPMENT

Part 1. **General Constraints on Resource Development**

Part 2. **Aggregate Resource Constraint Exercise**

CONSTRAINTS ON AGGREGATE RESOURCE DEVELOPMENT

Part 1. General Constraints on Resource Development

A. Geological

The available geological information on the resource may be limited by:

* the scale of mapping, i.e. generally at a 1:50,000 scale (1cm = 500m) such that only a broad definition of the location of the resource is available
* an areal delineation often derived from an analysis of aerial photography at a similar or larger scale
* the amount of sampling and testing that varies from area to area and only a few deposits will have been extensively test pitted or drilled and sampled.

As such, the geological mapping at 1:50,000 is considered only sufficient for land use planning purposes (i.e. definition of areas to be protected for future development consideration), but should not be considered adequate in determining the available quantity or marketability of the materials within these areas.

An aggregate producer would be expected to conduct a much more thorough sampling and testing program before considering to develop and seek licensing for a site within these mapped areas.

B. Location

The location of the resource is a frequent constraint to development due to the following limitations:

* The location of the resource is fixed by geology and the materials must be sought where they were deposited
* The location of the deposit must be within a reasonable haul distance of a ready demand or market area
* The deposit must have reasonable access to a transportation network to facilitate development of the site and the shipment of aggregate production to the consumer

C. Quantity and Quality

The aggregate resource materials must:

* be of an acceptable quality and free from excessive amounts of either deleterious lithologies or fine sized particles (silt or clay)
* be of a sufficient areal extent and deposit thickness (quantity) to provide an abundant supply of resources and reserves, to support economic aggregate production

* not be covered by overburden (unmarketable material) of a thickness that may preclude economic or environmentally acceptable resource development.

D. Land Use Constraints

Development of aggregate deposits (aggregate availability) are affected by land use constraints that preclude or limit either access to, or development of, the resource. The constraints include:

* incompatible and preemptive land uses on or adjacent to deposits that contain otherwise geologically acceptable materials
* municipal planning restrictions including official plan policies or designations and zoning by-laws that prevent development of the resource
* preemptive public interests including cultural heritage, parks, greenbelts, provincial interests (e.g., wetlands) etc.

An operator considering a new operation will carefully evaluate these concerns before proceeding to acquire extraction rights and proceeding with requests for municipal plan amendments as well as with a licence to operate. The Ministry of Natural Resources may not issue a licence for extraction unless the Official Plan and zoning permit it as a use. Land use and planning issues will frequently result in hearings before the Ontario Municipal Board if there are objections to the proposed development.

E. Environmental Constraints

Development of an aggregate resource is subject to limitations required to ensure the protection of the environment in and surrounding the site of the proposed extraction. These often very practical environmental limitations reduce the effective areas that may be developed for extraction.

Areas frequently excluded are:

* environmentally sensitive areas (flood plains, wetlands)
* areas of endangered species habitat
* areas of wildlife and fisheries habitat
* areas subject to regulatory requirements such as setbacks from licence boundaries, residential areas, roads, streams etc.

The environmental issues must be carefully assessed and various provincial ministries and agencies must be assured that the operation does not have a significant impact on the environment or local residents, and that measures are taken to mitigate any identified impacts.

F. Social Concerns

The development and licensing of an extraction operation generates societal concerns

particularly from neighbours in the immediate vicinity of the operation or along the haul routes used by trucks entering and leaving the site. Local residents are concerned and affected by:

* noise and dust from the operation or from trucks entering and exiting the site
* increased traffic, particularly trucks entering the site and hauling the product along local roads
* the aesthetic affect of the operation on the natural setting of the area and changes to the setting due to extraction
* the public interest conflicts of provincial and regional need for the resource versus the local concern for the social and aesthetic effects of extraction
* public perception of extraction as a locally unwanted land use.

These are issues that a prospective operator must consider when a new operation is being planned. The operator must be prepared to address these issues and where appropriate implement mitigative measures to reduce identifiable impacts. Operators may not be able to quantify certain impacts, such as those that may be perceptual in nature, or to change the public's perception of the effect of the proposed operation despite demonstration that mitigative measures can ameliorate the concern. In some of these cases it is important to recognize the emotional issue, some people do not want to live next to a pit or quarry and no amount of reasoning or facts will change their mind. Unfortunately, many people have moved into the rural areas where the resources occur without realizing that some of these resources will be developed. They may have left behind the urban hustle and seek a tranquil rural life style and may not recognize the province's dependency on aggregates.

Part 2. Aggregate Resource Constraint Exercise Town of Whitchurch-Stouffville and Township of Manvers

A. Objectives

The objectives of the aggregate resource constraint exercise were to:

* assess current land use constraints for the Town of Whitchurch-Stouffville and Manvers Township; the first within the Oak Ridges Moraine GTA and the other on the moraine but east of the GTA
* produce an estimate of potential available resources after applying a reasonable set of land use and environmental constraints
* demonstrate the limitations on the availability of the resource for new aggregate resource development and assess the need for protection and access to the resource for future resource development.

B. Data Compilation - Aggregate Resource Constraints

The starting base for the exercise was the selection of the potential resource areas defined

in the Aggregate Resources Inventory Papers as:

* Sand and Gravel Deposits of Primary Significance
* Sand and Gravel Deposits of Secondary Significance
* Bedrock deposits buried under less than 8m of overburden.

Such areas would typically include resource areas identified:

* by MNR as being of provincial significance and requiring protection
* within municipal planning documents as an area where extraction is a possible land use.

No additional geological constraints have been applied that would typically be considered by a responsible aggregate resource developer. It is therefore assumed, for the sake of these discussions, that within the potential resource areas, there are reserves of a sufficient quantity and quality for economic development. Further geological evaluations would normally show that in many parts of these resource areas this is not true. However, in the absence of more detailed geological data, this assumption has been carried forward.

The analysis consists of the application of a series of constraints related to environmental or land use issues. After the analysis, additional constraints to development remain, including:

* resource constraints with respect to quality or quantity of resources
* social constraints.

C. Data Compilation - Land Use Constraints

Land uses were compiled into a GIS database by the Ministry of Natural Resources. Sources of data included the municipal official land use plans, zoning by-laws and MNR natural resource and environmental protection information. The constraint data were summarized into three broad categories:

Preemptive Land Uses: Current land uses that sterilize or preclude access to the resource for future development or the resource has already been developed including the following designations and zoning in the official plan:

* Residential
* Institutional
* Commercial
* Industrial
* Extractive industry (areas already licensed under the Aggregate Resources Act)

Very Serious Constraints: These areas, while not preemptive in nature, do have environmental constraints or provisions for protection of features or values of Provincial Significance that may prevent or restrict aggregate development and could

include some or all of the following:

* Environmentally Sensitive Areas and Open Space Designations
* Areas of Natural and Scientific Interest (ANSI's) of Provincial Significance
* Wetlands (Class 1 and 2) of Provincial Significance
* Identified Wildlife Habitat (Deer Wintering Yards and Cold Water Fish Habitat)
* Conservation Authority Lands
* Agreement Forests or Mature Woodlots

Competing Land Uses: In these areas, future aggregate development is not normally precluded; however, there are some provincial, regional or local interests that must be carefully assessed and more complex mitigative measures adopted before licensing may be permitted. The constraints for this exercise included:

* ANSI's of Regional Significance
* Agricultural Soils (Class 1, 2 and 3)
* Wetlands of Regional Significance.

D. Data Analysis

The methodology employed considered of an evaluation of the overlap of first preemptive constraints on Potential Resource Areas, followed by the very serious constraints and then competing land uses.

The GIS data files were established as single entity files (i.e., one resource or land use type in each file). These data files were exported to a TYDAC SPANS system (GIS) and the areas of overlap for each constraint calculated and subtracted in sequence (starting from preemptive to very serious constraints and then the competing land uses) from the area of each potential resource type.

Table E-1 and Table E-2 were generated to summarize these analyses for each municipality. Figures 13 to 20, Chapter 3 show graphically the loss of potential resource areas due to the application of the three levels of constraints.

E. Constraints not Considered

Limitations in available data precluded the consideration of many constraints that a prospective aggregate producer would use to evaluate a property and that might be considered by the municipality and provincial agencies prior to approving either the land use or licensing of the property under the ARA. Section 3.5.5 of the report describes the constraints that were not included in the analyses.

Application of these constraints would further reduce the areas of the potentially resources available. The numbers presented are therefore maximum areas of potentially available resources and in excess of what is truly available for aggregate development.

Table E-1

Town of Whitchurch-Stouffville
Aggregate Resource Constraint Exercise

Constraint Type	1. Primary Deposits			2. Secondary Deposits		
	sq. km.	hectares	% of "1"	sq. km.	hectares	% of "2"
a: Potential Resource Area	21.79	2178.8	100.0	64.54	6454.2	100.0
Preemptive Land Uses						
Licensed pits	4.79	478.7	22.0	0.26	26.0	0.4
Residential	1.26	125.8	5.8	10.32	1031.8	16.0
Institutional	0.08	8.3	0.4	0.04	3.7	0.1
Commercial	0.77	76.9	3.5	2.61	260.6	4.0
Industrial (excludes pits)	0.00	0.3	0.0	0.57	56.8	0.9
b: Subtotal	**6.75**	**675.4**	**31.0**	**13.51**	**1350.8**	**20.9**
Very Serious Constraints						
Environmental (ESA)	0.00	0.0	0.0	0.18	17.6	0.3
Open Space	0.00	0.3	0.0	15.09	1509.4	23.4
ANSI's - Prov. Sign.	0.34	33.6	1.5	0.61	60.9	0.9
Wetlands- Prov. Sign.	0.00	0.0	0.0	0.05	5.4	0.1
Wildlife Habitat	0.00	0.0	0.0	0.00	0.0	0.0
Conservation Lands	0.00	0.0	0.0	0.08	7.7	0.1
Agreement Forests	1.92	191.7	8.8	25.62	2561.8	39.7
Mature Woodlots						
c: Subtotal	**1.71**	**170.5**	**7.8**	**25.07**	**2507.1**	**38.8**
Competing Land Uses						
ANSI's-Regional Sign.	0.16	15.6	0.7	0.00	0.0	0.0
Agriculture, Class 1-3 Soils	18.88	1888.4	86.7	23.20	2319.7	35.9
Wetlands-Regional Sign.	3.89	388.6	17.8	1.37	136.8	2.1
d: Subtotal	**12.68**	**1268.4**	**58.2**	**13.38**	**1338.0**	**20.7**
Summary						
e: Total Constraints (b+c+d)	**21.14**	**2114.3**	**97.0**	**51.96**	**5195.9**	**80.5**
f: Resources Remaining (a-e)	**0.64**	**64.5**	**3.0**	**12.58**	**1258.3**	**19.5**

Note: a: Potential Resource Area is the area of resources (e.g. ARIP) prior to applying constraints.
Note: Subtotals have been adjusted to discount areas of mutual overlap between constraint types.
Note: Numbers have been rounded to the nearest 10th of a percent and totals may not add up to 100.
Source: Ministry of Natural Resources, Resource Stewardship & Development Branch (1993)

Table E-2

Township of Manvers
Aggregate Resource Constraint Exercise

Constraint Type	1. Primary Deposits			2. Secondary Deposits		
	sq. km.	hectares	% of "1"	sq. km.	hectares	% of "2"
a: Potential Resource Area	30.00	2999.7	100.0	48.91	4890.5	100.0
Preemptive Land Uses						
Licensed pits	4.53	453.0	15.1	3.64	364.2	7.4
Residential	1.05	104.8	3.5	0.21	20.9	0.4
Institutional	0.17	17.4	0.6	0.03	3.2	0.1
Commercial	0.03	2.9	0.1	0.40	40.2	0.8
Industrial (excludes pits)	0.40	39.6	1.3	0.26	25.6	0.5
b: Subtotal	**6.06**	**606.2**	**20.2**	**4.30**	**430.5**	**8.8**
Very Serious Constraints						
Environmental (ESA)	0.00	0.0	0.0	0.00	0.0	0.0
Open Space	0.60	59.8	2.0	8.06	806.4	16.5
ANSI's - Prov. Sign.	3.53	353.3	11.8	3.58	358.2	7.3
Wetlands- Prov. Sign.	0.22	22.0	0.7	1.40	140.3	2.9
Wildlife Habitat	0.00	0.0	0.0	0.00	0.0	0.0
Conservation Lands	0.00	0.0	0.0	1.68	167.9	3.4
Agreement Forests	0.52	51.6	1.7	2.77	276.8	5.7
Mature Woodlots	0.00			0.00		
c: Subtotal	**4.31**	**431.0**	**14.4**	**14.54**	**1454.2**	**29.7**
Competing Land Uses						
ANSI's-Regional Sign.	0.00	0.0	0.0	0.00	0.0	0.0
Agriculture, Class 1-3 Soils	0.45	44.8	1.5	7.70	770.5	15.8
Wetlands-Regional Sign.	0.00	0.0	0.0	0.00	0.0	0.0
d: Subtotal	**0.45**	**44.6**	**1.5**	**3.25**	**325.4**	**6.7**
Summary						
e: Total Constraints (b+c+d)	**10.82**	**1081.8**	**36.1**	**22.10**	**2210.1**	**45.2**
f: Resources Remaining (a-e)	**19.18**	**1917.9**	**63.9**	**26.80**	**2680.4**	**54.8**

Note: a: Potential Resource Area is the area of resources (e.g. ARIP) prior to applying constraints.
Note: Subtotals have been adjusted to discount areas of mutual overlap between constraint types.
Note: Numbers have been rounded to the nearest 10th of a percent and totals may not add up to 100.
Source: Ministry of Natural Resources, Resource Stewardship & Development Branch (1993)

APPENDIX F

MINISTRY OF TRANSPORTATION AGGREGATE CONSERVATION MEASURES

Part 1. **MTO Recycling Initiatives**

Part 2. **Highway Design Innovations**

Part 3. **New Laboratory Test Procedures**

Part 4. **Highway Trial Test Sections**

Part 5. **Future Potential Recyclable Materials for MTO in Central Region**

MINISTRY OF TRANSPORTATION AGGREGATE CONSERVATION MEASURES

Part 1. MTO Recycling Initiatives

* Since the early 1970's, the ministry has allowed the use of steel slag and blast furnace slag in hot mix asphalt pavements. Due to a current review of the performance of slags in hot mix pavements, there is a moratorium on their use as asphalt mixes for MTO contracts. Blast furnace slag has been utilized as granular base, sub-base and shouldering aggregate and also in light weight fill applications and specialized light weight concrete uses.

* Reclaimed Asphalt Pavement (RAP) has been added extensively into hot mix asphalt pavements. On the average, the ministry used about 270,000 tonnes of this material per year from 1988 to 1991. RAP materials are also allowed to be blended into conventional granular base, sub-base and shouldering aggregates. Granular aggregates may contain up to 30 percent of asphalt-coated particles. Greater amounts may be specified by special provision on specific contracts.

* In Central Region, the yearly average of RAP use in hot mix asphalt pavement between 1988 and 1992 was 42,000 tonnes, which is about 8.6 percent of the total asphalt pavement laid (Table 18, Chapter 3).

* Reclaimed Concrete Material (RCM) is also permitted and used as granular base, sub-base and shouldering aggregate up to 100 percent of the total aggregate.

* Bottom ash and fly ash have also been used as engineered fill on MTO contracts.

* The ministry is also experimenting with the use of recovered municipal and construction wastes such as glass, porcelain, bricks and rubber (Senior, 1992 and Senior & Kendrick, 1993).

* Test projects have been undertaken to evaluate the use of rubber tires in bituminous pavements to possibly increase pavement life expectancy; and blends of crushed glass in granular base applications.

* Municipalities are encouraged by the MTO to utilize these technologies.

Part 2. Highway Design Innovations

Recent developments in highway design have enhanced the reduction of aggregate usage.

They can be summarized as follows:

* Using composite and concrete pavement designs for expressway type construction to reduce aggregate use
* Designing 'no waste' contracts where all recovered materials (earth, RAP and concrete) are reused
* Using special designs with high internal drainage to improve performance and reduce granular base and sub-base thicknesses

Part 3. New Laboratory Test Procedures

New laboratory test procedures are being constantly investigated to provide better evaluation of aggregate materials. These investigations provide the following benefits:

* Better test methods ensure that highways and roads will last longer, reducing future need for aggregates
* Some aggregates that were considered unacceptable due to less efficient test methods are now considered acceptable due to better testing technology

Part 4. Highway Trial Test Sections

Trial test sections ensure better utilization of aggregate materials and reduce cost by facilitating approval of new aggregate sources which may perform better than aggregates used previously. Current test sections involve several granitic and volcanic rock types for premium quality surface asphalt and high quality coarse gravels for premium quality binder asphalt pavements.

Part 5. Future Potential Recyclable Materials for MTO in Central Region

A. Location

In certain instances, Reclaimed Asphalt Pavement (RAP) is made available within ongoing contracts and is being utilized on the same contracts. In some circumstances RAP may be transported from one contract to another.

There are large stockpiles of RAP existing at permanent asphalt plant locations. These are potential sources of supply for MTO and municipal contracts. The use of these materials is, however, subject to engineering constraints that prevent their use on many construction projects.

Recovered Concrete Material (RCM) is available in several permanent asphalt plant locations and commercial aggregate recycling plants.

B. Quantity and Quality

It is expected that RAP in asphalt pavements will be used approximately at the average of previous levels (about 42,000 tonnes/year). A potential increase is curbed by the fact that in Central Region, the main asphalt surface types are premium asphalt pavements. For these pavements, RAP is of too low quality to be utilized.

The main use of RAP will be in granular base and sub-base uses. Current practice is to allow 30 percent RAP in these materials. This could potentially amount to about 2.6 million tonnes over the next five years.

It is expected that the use of RCM will be:

* relatively low for highway contracts
* utilized mostly by municipalities within Metropolitan Toronto near the origin of demolition of concrete structures, sidewalks and pavements.

Other recycled materials such as glass or ceramics will be available in small quantities and can be blended into granular materials.

C. Use Limitations

While recycled materials can be utilized as substitutes for natural aggregates (sand, gravel or crushed rock) in highway construction, there are limitations regarding their use. These limitations are as follows:

Technical:

Reclaimed Asphalt Pavements are subject to a number of technical limitations including:

* current moratorium on the use of steel slag and iron blast furnace slag as asphalt paving coarse and fine aggregates due to unacceptable performance in premium quality surface course pavements
* RAP containing steel slag may not be used in expressways due to its expansive nature
* Steel Slag RAP may still be used on two lane highways and municipal roads as granular base and sub-base on an experimental basis, if blended with 70 percent natural aggregates
* RAP can also be used up to 100 percent as shoulder gravel in any road
* RAP containing steel slag may be used as engineering fill only on an experimental basis and is not to be used as backfill for structures, culverts, sewers or trenches due to its expansive nature
* RAP that does not contain steel slag may be added in up to 50 percent of the total asphalt mix in asphalt pavements
* RAP containing higher percentages may cause reduction in pavement quality and air quality (emission) problems at asphalt plants.

Other recycled materials (e.g., glass, ceramics, bricks and rubber) have similar limitations such as:

* it may only be used experimentally on a site specific basis and should be blended into natural granular aggregates at low percentage
* glass may not be used in Portland cement concrete due to its reaction and expansion with Portland cement.

Environmental:

Environmental limitations of RAP mean it may not be placed in any other location, except:

* in the road within the right of way
* in a controlled landfill site
* below the subgrade of the road or in a berm within the right of way, not closer than one metre from the final side slopes of embankments and no closer than 30 metres to an open body of water and a minimum of two metres above the nominal ground water table.

Iron blast furnace slag and other recycled materials such as glass, ceramics, brick or rubber may only be used:

* in the road base, sub-base or pavement
* after site specific approval by MOEE.

Recovered Concrete Material (RCM) does not have the same environmental limitations as RAP. RCM is classified as an inert fill and is acceptable for reuse or as a disposable fill.

APPENDIX
G

MNR'S AGGREGATE RESOURCES PROGRAM AND THE AGGREGATE RESOURCES ACT

Part 1. **MNR's Aggregate Resources Program**

Part 2. **Aggregate Resources Act Summary**

Part 3. **Sample Site Plans - Aggregate Resources Act**

MNR'S AGGREGATE RESOURCES PROGRAM AND THE AGGREGATE RESOURCES ACT

Part 1. MNR's Aggregate Resources Program

The objective of MNR's aggregate resources program is to ensure the availability, resource conservation and orderly development of aggregate resources with minimal adverse impacts on society and the environment. To achieve this objective, the MNR has adopted an integrated approach to aggregate resource management.

This integrated approach has three overall strategies:

* Industry Regulation
* Resource Planning
* Resource Conservation

Part 2. Aggregate Resources Act Summary

Aggregate Licences

Aggregate licences are applicable only to private land in the areas that have been designated (mainly in southern Ontario) under the Aggregate Resources Act and its regulations, Figure 22.

There are two types of aggregate licences:

Class A licence:
* for extraction of > 20,000 tonnes per annum
* requires a full environmental and social assessment

Class B licence:
* for extraction < 20,000 tonnes per annum.

When acquiring a licence the following is to be considered:

* Effect on the environment and the surrounding community
* Effect on the ground and surface water
* Municipal comments
* Rehabilitation of the site
* Effect on agriculture
* Planning and land-use considerations
* Haulage routes
* Quality and quantity of aggregate on site

Under the ARA the municipality retains its authority provided under the Planning Act by:

* retaining control over the location of pits and quarries (zoning must permit extraction as a use before a licence can be issued)
* using zoning laws with which a licence has to comply
* the provision for appeals of licence applications to the Ontario Municipal Board.

Operators pay an annual fee equivalent to 6 cents/tonne. This fee is distributed as follows:

* 4 cents to the local municipality
* 1/2 cent to the County/Region
* 1/2 cent to the Abandoned Pit and Quarry Rehabilitation Fund
* 1 cent to the Province

Wayside Permits

Wayside permits are issued under the Aggregate Resources Act to public authorities or their contractors for provincial highway or municipal road projects on private lands in designated parts of the province (mainly southern Ontario), as set out by Regulation 15 accompanying the ARA. Wayside permits may also be issued for urgent projects such as emergency flood control, road or dam repair.

Prior to the issuance of a wayside permit, the following items are to be considered:

* The necessity for the aggregate must be indicated
* The method of operation and rehabilitation must ensure that the operation and disturbance is temporary
* A wayside permit fee similar to licence fee is required
* A detailed site plan including a rehabilitation plan is mandatory (ARA Section 25)
* Comments of the municipality where the site is located
* Effect on the environment and nearby communities
* Amount of tonnage to be removed
* A cost comparison with alternate sources
* Management of aggregate resources
* Previous permits on the site
* The proposed rehabilitation and its compatibility with adjacent land
* Any possible effects on groundwater
* Proposed aesthetic improvements to the landscape
* Haulage routes and proposed truck traffic

A wayside permit may be issued without a zoning by-law amendment due to its temporary nature, although, not in areas of particular environmental sensitivity or in areas zoned residential. A copy of the wayside permit is supplied to the local

municipality. The wayside permit is issued with appropriate conditions, including:

* maximum tonnage to be extracted
* an expiry date that coincides with the completion of the project or 18 months, whichever comes first
* rehabilitation must be completed prior to final acceptance or release of any hold backs on the construction project
* the permit can be suspended or revoked by the Minister upon sufficient cause.

Consultation is required prior to the issuance of a wayside permit as follows:

* The ARA (Section 26) and the MARPS (Principles) requires consultation with municipalities
* Prior to issuance of a permit MNR obtains comments from municipalities which influence the decision as to whether the permit should be issued or not and can determine the conditions of operation and the character of rehabilitation
* The MTO Provincial Highways Class Environmental Assessment Document requires that each time Public Information Centres are held for a project, information on aggregate needs (quantity and type) are to be presented
* According to the requirements of MTO Directive B-14 (Part 2, Appendix H), MTO will consult with municipalities regarding aggregate requirements and potential aggregate wayside sources for each major project. These comments influence the selection of proposed extraction sites and the conditions for operation, haulage and rehabilitation.

Examples of wayside permit rehabilitation were shown on the July 23, 1992 field tour (ORMAC, 1992) and in the Feb. 4, 1993 presentation to the ORMTWC (e.g. Nesbitt pit south of Coppins Corners and Kennedy pit at Hwy. 404).

An example of a rehabilitated wayside pit is illustrated in the Pictorial of Progressive Rehabilitation in Figures 25(a) to 25(d). The site:

* is located on Lot 21, Concession VI, Town of Halton Hills (Esquesing)
* lies within the Niagara Escarpment Plan Area
* was used on several MTO contracts between 1973 and 1977
* supplied approximately 250,000 tonnes of aggregate for use on projects involving the construction of the 403 Freeway
* has been returned to a state which is very near to its original condition prior to extraction.

MNR is satisfied that Directive B-14 and Special Provision 199S38 will ensure continued high quality and creative rehabilitation on non-commercial aggregate extraction sites on future MTO contracts.

Crown Land Aggregate Permits

There are three different types of Crown land Aggregate Permits:

* Commercial: for the purpose of resale
* Public Authority: mainly for provincial highway or municipal road projects or for use by the public authority but not for resale or commercial purposes
* Personal: issued for individual use but not for resale or commercial purposes.

The objectives of providing Crown land permits are to ensure:

* resource conservation and management
* environmental protection
* public safety
* generation of fair and equitable revenue for the use of Crown resources.

A Crown land aggregate permit requires a detailed site plan including a rehabilitation plan (Section 36(4)). The rehabilitation of the site must be completed prior to the expiration of the permit. The permit duration is for a fixed period of time of not more than a five year term; however, permits are renewable. To minimize adverse impacts, conditions may be added to the permit at any time. Nevertheless, upon sufficient cause, an aggregate permit may be revoked.

An aggregate permit is also required for the removal of aggregate from land under water, whether it be private land or Crown land. This aggregate permit allows for:

* underwater dredging for aggregates
* other forms of extraction of aggregates covered by water but excludes land covered by water as the result of extraction below the water table.

Typically in any given year there are less than 20 aggregate operations extracting aggregate under water.

Part 3. Sample Site Plans - Aggregate Resources Act

The following four figures are photo reduced copies of sample site plans that have been prepared by MNR to assist aggregate licence applicants with the preparation of their site plans. Sample site plans include:

* existing features map (Figure G-1)
* operational plan (Figure G-2)
* progressive and final rehabilitation plan (Figure G-3)
* sample cross sections (Figure G-4).

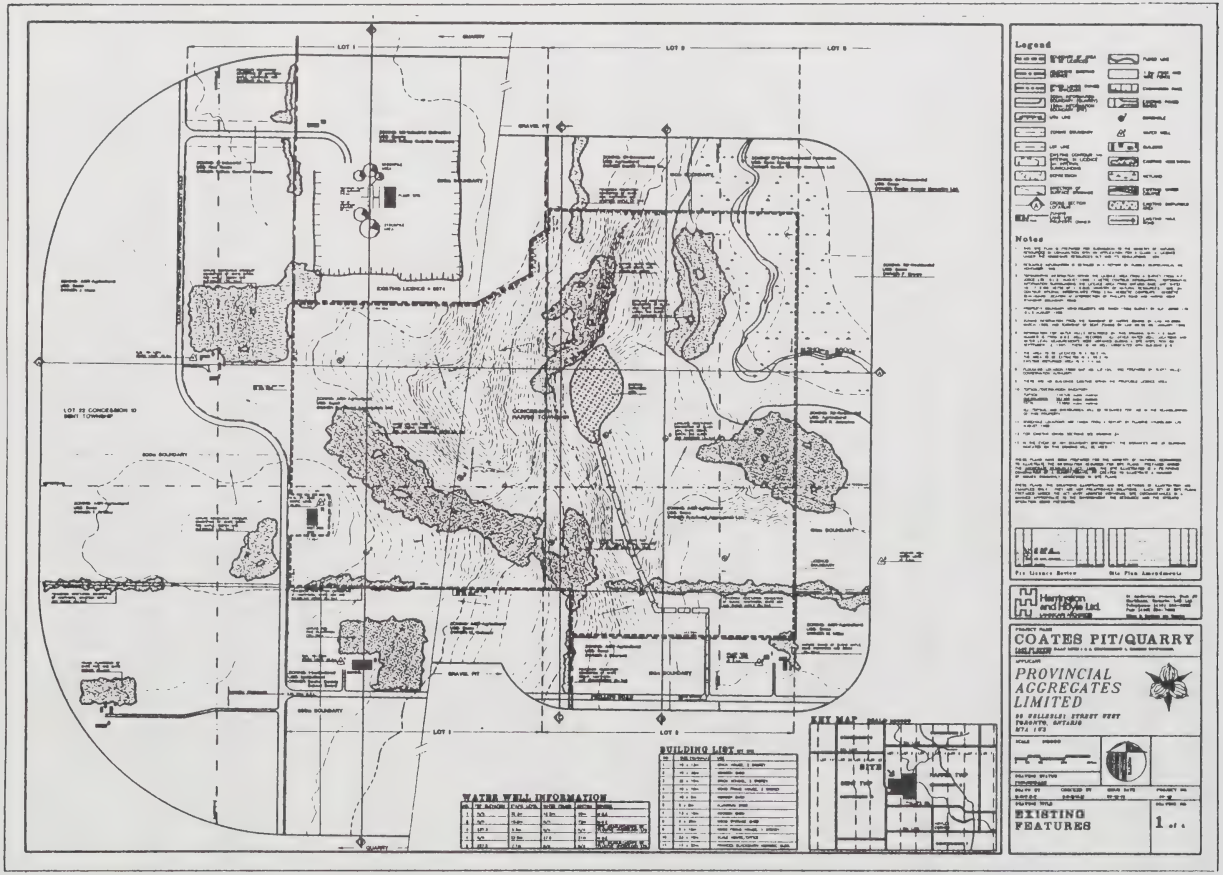


Figure G-1: **Existing Features Map - Sample Site Plans, Aggregate Resources Act.**

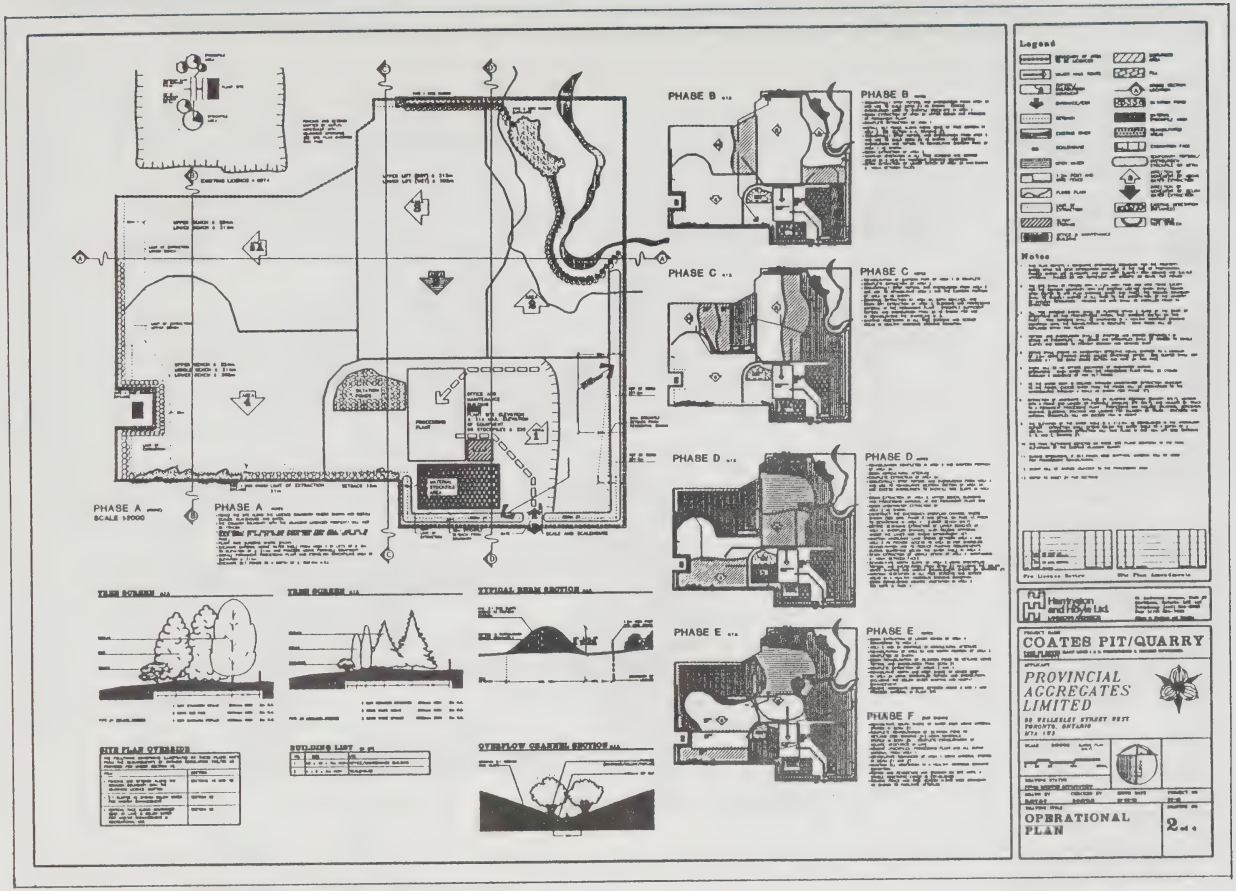


Figure G-2: **Operation Plan - Sample Site Plans, Aggregate Resources Act**

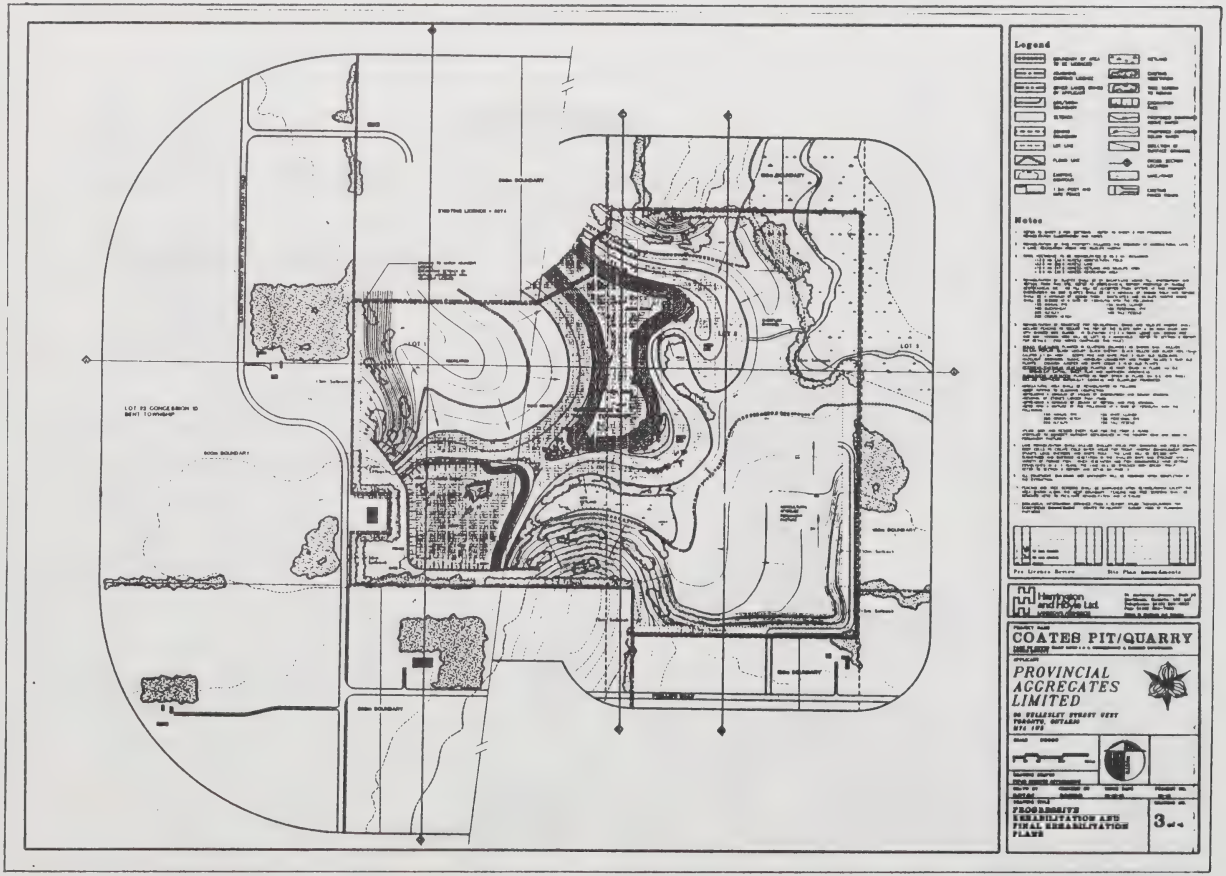


Figure G-3: **Progressive and Final Rehabilitation Plans - Sample Site Plans, Aggregate Resources Act**

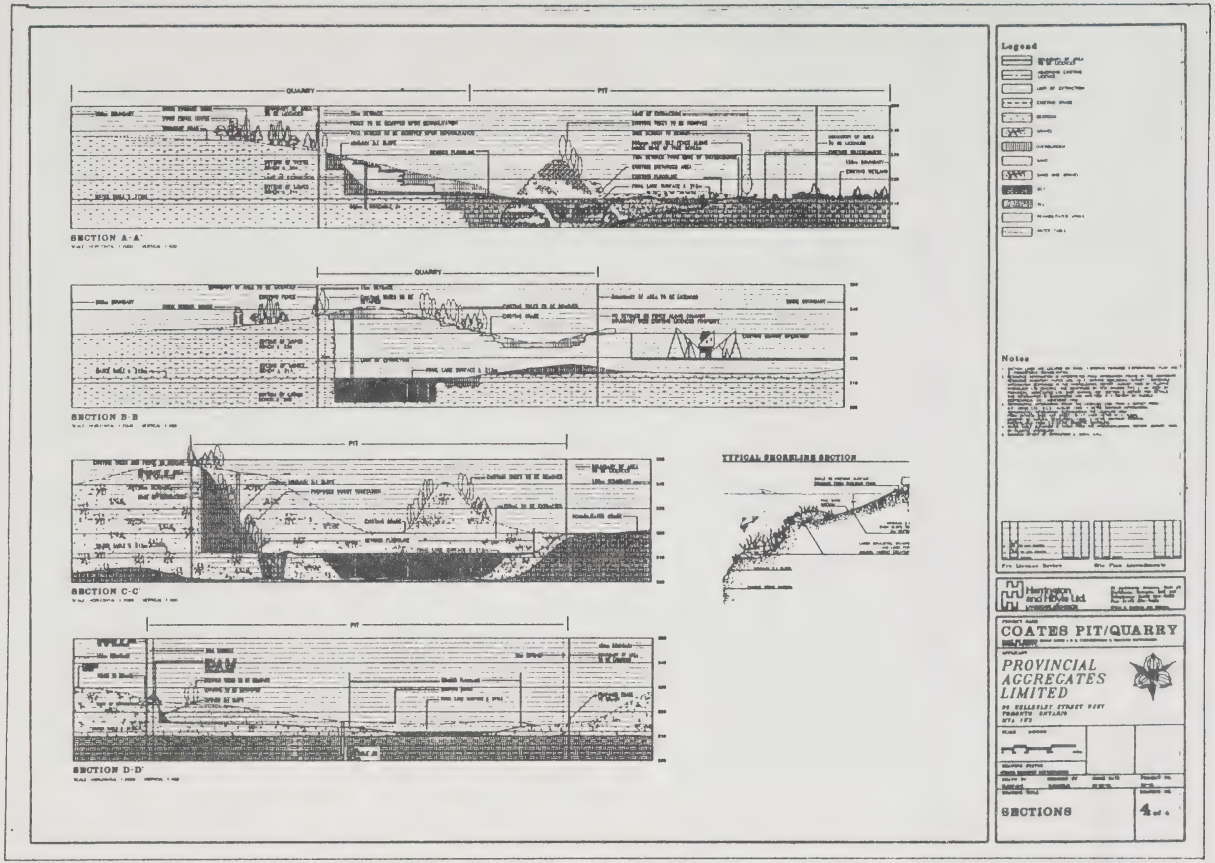


Figure G-4: **Cross Sections - Sample Site Plans, Aggregate Resources Act**

APPENDIX
H

MINISTRY OF TRANSPORTATION PROJECT CLEARANCE PROCESS

Part 1. **MTO Class Environmental Assessment Process**

Part 2. **MTO's Interministerial Protocols and Agreements**

MINISTRY OF TRANSPORTATION PROJECT CLEARANCE PROCESS

Part 1. MTO Class Environmental Assessment Process

The Ministry's new Class EA was approved by the Ministry of the Environment and Energy in December 1992, (MTO, 1992) replacing the previous Class EA approved in 1985.

In the Ministry of Transportation, class environmental assessments:

* have been prepared for many projects, approved and used extensively
* have resulted in the efficient implementation of projects in an environmentally sound manner
* have allowed for timely delivery of projects.

In applying the requirements of the EA Act to highway projects, MTO has defined four groups of projects or activities. Ministry projects or activities receiving approval through the 1992 Class EA process are subdivided into Group "A", "B", "C", and "D" projects. This is in order to ensure that the purpose and intent of the EA Act is achieved while at the same time providing a streamlined and efficient approach to the administrative requirements of the EA Act.

Group "A" Projects:

* Involve major new highway facilities such as new routes, by-passes and major re-alignments
* Are complex with a range of environmental effects
* Require an individual environmental assessment report which is subject to full review and approval from the Ministry of the Environment and Energy

Examples of Group "A" projects are Highway 407, the future northerly extensions of Highways 404 and 410, and the Caledon and Bradford by-passes.

Group "B" Projects:

* Involve improvements to existing highways and new highway service facilities such as the widening of existing highways and building new interchanges and service centres
* Are less complex and have less potential for environmental effects than Group "A" projects
* Are approved under the EA Act subject to compliance with the MTO Class EA process which ensures the purpose and intent of the EA Act is fulfilled

Examples of Group "B" projects are the Highway 401 widening (Scarborough/Ajax and Milton/Cambridge), the Highway 400/Rutherford Road Interchange and the Highway 401 Information Centre in Mississauga.

Group "C" Projects:

* Generally involve maintenance operations, rehabilitation activities, operational improvements and property management associated with existing highways
* Are approved under the EA Act subject to screening for environmental effects

Examples of Group "C" projects include asphalt/concrete patching, shoulder repair, snow and ice removal; safety devices such as barriers, lighting and traffic control devices; and roadside parks/rest/picnic areas and commuter parking lots.

Group "D" Projects:

* Specifically involve MTO activities which are subject to compliance with other legislation such as the ARA and the Environmental Protection Act (EPA) and associated interministerial protocols and agreements
* Compliance of Group "D" activities with the appropriate legislation (i.e., ARA or EPA) and protocol or agreement constitutes compliance with the EA Act regarding assessment and mitigation of environmental effects

Activities associated with Group "D" projects include:

* excess materials management for old asphalt and concrete, earth and fill; transfer or temporary storage of excess material; and material sorting, re-use and recycling
* construction, operation and closure of non-hazardous or commercial waste disposal sites, less than 40,000 cubic metres in capacity, which have been approved under Part V of the EPA
* emergency response activities such as spill containment, spill clean-up, or transportation, transfer and temporary storage of spill, clean-up or abandoned material
* aggregate resource activities such as extraction, processing, transportation and site rehabilitation.

Since this latter Group "D" activity is of particular interest to the Oak Ridges Moraine Planning Study, the following section provides a brief explanation of the MTO protocols and agreements in place under its 1992 Class EA.

Part 2. MTO's Interministerial Protocols and Agreements

In order to meet the requirements of legislation and regulations controlling MTO undertakings, more specifically aggregate extraction, interministerial procedures (Directive B-14) have been developed. Predecessors of this directive have been in place since 1977 (MTO, 1978 & MTO, 1981).

Quality and Standards Directive B-14, Procedures for Administration of Mineral Aggregate

Extraction on Ministry of Transportation Projects (MTO, 1993b) and adjunct MTO Report MI-155 (MTO, 1993c) was developed to:

* provide a mechanism to ensure the availability of aggregate materials for MTO projects
* outline procedures for MTO and MNR to interface with affected municipalities and evaluate concerns of municipalities
* outline a process for issuance of wayside permits and aggregate permits
* outline the necessary lines of communication between MNR, MTO, Ministry of Culture, Tourism and Recreation (MCTR), municipalities and other public agencies regarding development, operation and rehabilitation of pits and quarries on MTO projects
* identify a procedure that addresses potential conflicts between wayside pits and archaeological sites
* outline a procedure for obtaining approval for permit approval for temporary aggregate extraction sites
* include pre-contract consultation and project management.

Pre-Contract Consultation

On highway construction, MTO consults with MNR District Offices and municipalities regarding:

* project location and description
* aggregate type and quantity requirements
* proposed aggregate test sites.

Areas of sensitivity are identified and either eliminated from further testing or undergo closer scrutiny as follows:

* Specific environmentally sensitive areas are eliminated from further testing
* Areas which contain archaeological or heritage sites are specifically examined
* Additional field investigation is carried out by MTO

Aggregate Sources List

For each project a proposed Aggregate Sources List (ASL), consisting of a listing of commercial sources and proposed wayside sources, is then prepared by MTO. Input is requested as follows:

* The proposed ASL is forwarded to MNR, municipalities and MCTR for comments, particularly with respect to proposed wayside sources
* Comments received for wayside sources regarding land use, haul routes, social and environmental concerns and comments regarding archaeological sites are evaluated by the MNR District Office according to criteria set out in Section 26 of the Aggregate Resources Act

* Those sources which pass the criteria may be given clearance to be listed on the ASL for the project with appropriate conditions. The issuance of the wayside permit for a sites with clearance is then guaranteed to the Contractor on the ASL and by MTO Special Provision 199S38 (MTO, 1977).

Contract Management

The contractor may select any of the licensed commercial sources or any of the pre-cleared wayside sites, listed on the ASL for use on the contract, subject to the following terms:

* If a wayside site is selected by the contractor, the contractor must submit an application for a wayside permit together with a site plan to the MNR District Office. The site plan must reflect the conditions of operation, haulage and rehabilitation determined during the pre-contract consultation process.
* If the permit application and site plan is considered acceptable by MNR according to the requirements of the Aggregate Resources Act and the comments received from the municipality and other ministries, the permit will be issued.
* The operation and rehabilitation of the wayside pit is inspected by MNR. The rehabilitation according to the site plan is ensured by MTO, additional to the requirements of the Aggregate Resources Act by a money hold back procedure.
* If the contractor selects a wayside site which has not been cleared during the pre-contract consultation process and consequently has not been listed on the ASL, the contractor is responsible for carrying out additional consultation, obtaining site clearance and providing all information required by the Aggregate Resources Act (Section 26).

There is a Memorandum of Understanding between the Ministry of Natural Resources and Ministry of Transportation, concerning the Approval of Aggregate Sources List (ASL) and the Issuance of Permits with respect to the Aggregate Resources Act, RSO 1990 C.A.8. This Memorandum of Understanding is a formal agreement that:

* requires the two ministries to have detailed consultation with municipalities and other involved agencies regarding issuance of wayside permits and aggregate permits
* establishes procedures for identification and listing of potential wayside sites and the permit process outlined in MTO Report MI-155 (OMTO, 1993c)
* requires periodic review by MTO and MNR to ensure that the procedures meet the requirements of regulations and policies relating to aggregates.

MTO also has a Memorandum of Understanding with the Ministry of Northern Development and Mines with respect to the Mining Act, R80 1990 C.M. 14 and the clearance of potential quarry sites on private land not designated under the Aggregate

Resources Act. The agreement:

- requires a full environmental review prior to issuance of a Notice of Mine Production and Rehabilitation document, the Closure Plan (procedures described in MTO Report MI-155)
- requires periodic review for possible revisions
- is not applicable in the Oak Ridges Moraine part of the GTA since it is designated under the ARA.

A specific Memorandum of Understanding between MNR and MTO, covers the issuance of wayside permits in the Town of Caledon.

- This was necessitated by the continuous use of aggregates from wayside pits located in the Town for highway projects in the western part of the Greater Toronto Area.
- It makes specific references with respect to municipal consultation and site reviews (procedures described in MTO Report MI-155).
- It is currently being reviewed by MNR, MTO and the Town of Caledon.

The following are Special Provisions describing the contractors precise obligations on MTO contracts in the contractual agreement (MTO, 1977):

- Special Provision No. 199S38, Administration of Aggregate Resources including Earth and Rock Borrow, relates to wayside permits, aggregate permits, letters of approval, notices of mine production and closure plans, and permits to extract aggregates from Indian Reserve Land. The special provision describes the operational regulations and rehabilitation requirements for lands which are not covered by the Aggregate Resources Act, the Mining Act and the Indian Act. The control of contractors haulage and reconstruction of haul roads after completion of each contract is also described. The special provision is also included in Report MI-155.

- Special Provision No. 199S30, Management and Disposal of Excess Material, details the requirements of the contractor regarding disposal of all excess material originating from contracts including asphalt pavement, swamp material, wood, etc. The special provision ensures that these materials will be disposed according to current environmentally accepted methods and that disposal will not pollute land or water.

- Special Provision 101S02, Archaeological Finds, ensures that any archaeological finds will be protected if they are found within the contract limits or in pits or quarries used for Ministry contracts. As described previously, MTO Report MI-155 identifies a procedure to address potential conflicts between wayside pits and archaeological sites.

- Special Provision 199F12, Environmentally Sensitive Areas, ensures that areas adjacent to contracts that have been identified as environmentally

sensitive, are not entered or used by the contractor for any purpose related to the contract. There is also a special agreement called "A Fisheries Protocol" between MTO and MNR for protecting fisheries resources on provincial highway undertakings. This agreement is related to the MTO Class EA process. Its primary purpose is to establish standard requirements and a consistent cost-effective approach for MTO and MNR in protecting fish habitat with respect to provincial highway undertakings.

APPENDIX I

AGGREGATE PRODUCERS' ASSOCIATION OF ONTARIO

Part 1. Mission Statement

Part 2. Code of Responsibility

Part 1. Mission Statement

AGGREGATE PRODUCERS' ASSOCIATION OF ONTARIO

MISSION STATEMENT

The Aggregate Producers' Association of Ontario exists to promote the wise management of Ontario's aggregate resources in a manner which is conducive to conserving the natural and social environment while maintaining a healthy and competitive aggregate industry.

OBJECTIVES

- To promote and maintain industry understanding with all levels of Government and other concerned bodies.
- To encourage the protection, development and utilization of (non-renewable) aggregate resources with concern for, and regard to, the principles of conservation and the impact on the natural and social environment.
- To promote a high code of business ethics throughout the membership.
- To promote good relations with customers, employees, media, other Associations and the general public.
- To improve and promote safe conditions and working practices for employees, and to promote safe practices in the transportation of industry products.
- To provide quality products for consumers.
- To constantly upgrade the industry image and assist the members to be good corporate citizens.

Part 2. Code of Responsibility

AGGREGATE PRODUCERS' ASSOCIATION OF ONTARIO

CODE OF RESPONSIBILITY

- Members shall comply with the Aggregate Resources Act, the Environmental Protection Act and related legislation as a minimum standard for aggregate operations, environmental protection and rehabilitation.
- Members shall plan operations to conform with the principles of wise resource management.
- Members shall conduct their business honestly and fairly with customers, employees, sub-contractors and suppliers.
- Members shall uphold the principle of appropriate and adequate compensation for the service which they render.
- Members shall cooperate to extend the effectiveness of the Association by exchanging information and experience and supporting the Association's objectives.
- Members shall avoid conduct or practices detrimental to the aggregate industry, to the Association, to the reputation of any member or to customers.
- These responsibilities are freely and solemnly assumed as they form part of an obligation as a member of the Aggregate Producers' Association of Ontario.

APPENDIX
J

EXAMPLES OF FORMER EXTRACTION SITES IN ONTARIO WITH HIGH BIODIVERSITY

EXAMPLES OF FORMER EXTRACTION SITES IN ONTARIO WITH HIGH BIODIVERSITY

Observations of abandoned extraction sites in Ontario are beginning to demonstrate that biodiversity can be achieved with sometimes dramatic results. Some examples include:

Wainfleet Wetlands (Port Colborne area)

* These former clay pits are now a class 1 wetland with a high biological component score.
* Forested swamp and cattail marsh have developed within the marsh.
* The wetland supports such species as wood duck, short-billed marsh wren, Virginia opossum and southern arrowwood.

South Gower Pit (Kemptville area)

* This former gravel pit is now part of a class 1 wetland complex marsh with many emergent aquatic plant species.
* The marsh is now being used by beaver.
* It is also a feeding area for great blue herons from a nearby heronry.
* Shorebirds use it for breeding and for feeding during migration.

CN Pit (Vespra Township) - Figure J-1

* This former sand and gravel pit has been naturally colonized by Little Bluestem, a rare native prairie grass.

Kerncliff (Burlington)

* Diverse vegetation occurs on both the walls and floor of this former quarry.
* Numerous breeding bird species, including the Virginia rail, sora rail and yellow-billed cuckoo, inhabit the quarry.
* A snake hibernaculum here is used by eastern garter snake, northern ribbon snake and eastern milk snake.
* There is documented use by 8 species of amphibians.

Roadway Pit (Whitchurch/Stouffville) - Figure J-2

* It is now a disused pit (although still licensed) on the Oak Ridges Moraine.
* A variety of wildlife inhabit the pit including coyote, red fox, cotton tail rabbit, field sparrow, woodcock, and red-tailed hawk.

Sites which have been deliberately rehabilitated for wildlife habitat are just beginning to appear. Examples of these include a wayside pit in Williamsburg Township (Figure J-3), Preston Sand & Gravel pit at Snyder Flats in Waterloo and a pit near Fletcher Creek now owned by the Hamilton Region Conservation Authority.

Figure J-1
Revegetation: Abandoned CN Sand and Gravel Pit, Vespra Township, Simcoe County

Figure J-1(a): A portion of the pit floor which has been naturally colonized by Schizachyrium scoparium (Little Bluestem), a rare Ojibway prairie grass native to Ontario. Seeds of this grass are very hairy and give a white "cottony" appearance in the fall of the year.

Figure J-1(b): Part of a large colony of Habenaria hyperborea (Northern Green Orchid) growing on the wetter part of this abandoned pit site.

Figure J-2
Examples of Wildlife Habitat in Former Extraction Sites

Figure J-2(a): The Roadway Pit, located on the Oak Ridges Moraine in the Town of Whitchurch-Stouffville is still licensed but has been inactive for about 10 years. Excellent wildlife habitat. Good microtopographic variation - mounding of material, presence of boulders and cemented gravel chunks. Background was sloped and seeded but the foreground was left un-rehabilitated and shows natural regeneration.

Figure J-2(b): The Crieff Pit near Fletcher Creek in Puslinch Township, Wellington County was inactive for about 10 years before removal of the remaining gravel and final rehabilitation by the Hamilton Region Conservation Authority in 1990. The site was deliberately rehabilitated in a manner to enhance the wildlife habitat.

Figure J-3
Wildlife Habitat and Enhanced Biodiversity at a Wayside Pit in Williamsburg Township

Figure J-3(a): This wayside pit, located near Morrisburg in Eastern Ontario, was extracted in a manner to produce both deep and shallow water areas and rehabilitated for wildlife habitat. The uneven bottom, sinuous shoreline and small islands were designed to enhance the diversity of the aquatic biota. This photo was taken in October, 1992 just after work was completed and the pond was beginning to fill in.

Figure J-3(b): Same wayside pit site, 1 year later in August, 1993. After only one growing season cattails and sedges have naturally colonized most of the shoreline. Wildflowers such as Gerardia purpurea (purple geradia) are present and minnows and frogs can be found in the pond.

Techniques to Enhance Biodiversity

It is no longer acceptable to wait 30 years for a site to become a valuable wildlife area. There are relatively inexpensive techniques which will aid the process of natural succession. With a carefully planned progressive rehabilitation program a pit or quarry can support a wide variety of species even while extraction is on-going.

Physical (topographic) diversity will lead to biological diversity. Micro-topographic variation (Figure J-2) on slopes and floors can be created by mounding of material and leaving large boulders exposed at the surface.

Variation in slope angles and aspects should be strived for, including the presence of some vertical faces (in quarries) which will often support unusual plant and animal communities.

A variety of soil types and overburden types should be used to form the surface on different parts of the site as described in the following examples:

* A fertile topsoil will create rapid plant growth but non-native weed species present in the seed bank will be the dominant growth
* It is best to use topsoil in areas that are to be seeded or planted by the operator and use subsoil and waste rock on other portions of the site
* Plants such as white ash, native dogwoods, and strawberry can colonize even rocky talus quite quickly on their own

Steep slopes subject to erosion should be seeded quickly with a grass/legume mixture. Perennial rye, a relatively short lived bunch grass which establishes quickly and is not too competitive, makes a good nurse crop to use with other more longer lived species. It has good drought tolerance and is adapted to a wide range of soils, including compacted soils.

Creeping red fescue, a rhizomatous species that forms a dense turf, is often used in seed mixes. It is claimed that this species is drought tolerant but in the wild it persists only on fertile and moist soils. A better choice seems to be hard fescue which has a high root/shoot ratio for holding soils and is tolerant to drought and low fertility. Hard fescue is a bunch grass and not strongly competitive, thus allowing native plant species to become established over time.

Tall fescue is a coarser grass adapted to a wide range of soils and very tolerant of drought, heat, shade, salt, and traffic. However, it is extremely competitive and is crowding out native species along river valleys in southwestern Ontario. Therefore, this is not a good species to choose if biodiversity is a goal of the rehabilitation plan.

Forage grasses may also be used in seeding slopes and include species such as timothy, smooth brome, and orchard grass. Timothy is adaptable to a wide range of conditions and is especially good in heavier soils. It is a non-aggressive bunch grass and will allow other plants to colonize. Brome grass is more drought tolerant than timothy but highly competitive and can slow natural succession for many years.

All of the above grasses are non-native species introduced from Europe. The use of native wild grasses and sedges for rehabilitation is increasing. These species are often more drought tolerant than the European ones and do not require fertilizer applications. The Ministry of Natural Resources is currently testing a variety of grass species, including some native ones, on plots set up in different pit and quarry sites. These are being monitored for species survival, growth and rate of natural succession.

Tree seedlings should not be planted into dense grass stands where they will be out-competed for light, water and nutrients. It is better to plant into bare ground, apply herbicides, or use a mulch around seedlings. Mulches can include wood chips, bark, paper sludge, even gravel. A mulch helps to keep moisture in the soil next to the seedling as well as to prevent competing weed growth. Use of some mulches with very high carbon to nitrogen ratios may require initial fertilizer additions.

Mixed tree plantings can aid in weed control where a rapidly growing species acts as a nurse crop for more slowly growing species. Black walnut growth, for example, can be increased by inter-planting with black locust which provides competition control, wind protection, and increases soil nitrogen levels with its nitrogen fixing abilities. The Ministry of Natural Resources is currently establishing tree seedling trials on pit and quarry sites to determine the best inter-planting combinations including a site near Caledon on the Oak Ridges Moraine.

Other planting techniques to consider include moving sod pieces from areas of the site about to be stripped to worked out areas ready for rehabilitation. These pieces do not have to cover the whole area but rather are left as scattered "islands". Such island plantings have been used to reproduce native grassland communities. Wet soils such as organic mucks and peat often contain a large seed bank of wetland species. These soils can be spread in the shallow waters of new ponds and wetland bottoms to produce a diverse array of aquatic plants.

The presence of standing surface water, Figure J-2(b), will greatly increase the biodiversity of a site. However, deep water bodies with no shallows, and square basins with no islands, bays or peninsulas to create sheltered water areas are of limited wildlife value. A good shoreline profile is low-angled with many curves. Extensive shallow-water areas (less than 1.5 m deep) and seasonally flooded wet areas are very productive. In large pits without shelter, wave action will erode shallows and prevent plant establishment. Shallows should be created on the leeward side of shores (consider the direction of the prevailing winds), or be protected by islands, peninsulas and shelter-belts. Large fallen trees at the waters edge provide resting sites for waterfowl and feeding and cover areas for fish.

Improving Fisheries Habitat with Pits

In determining the potential of an extraction site for rehabilitation to fish habitat the water quality, especially variations in temperature and dissolved oxygen content, as well as the seasonal fluctuations in water depth should be considered.

Brook trout have a preferred temperature range of 16 - 18 °C and a minimum requirement

of >6 mg/L dissolved oxygen. Largemouth bass on the other hand can survive in water temperatures as high as 29 - 32 °C and dissolved oxygen levels as low as 2 mg/L. If the pond or lake has groundwater as its major source of supply then conditions are probably suitable to support cold water fish species (e.g., brook and rainbow trout).

A passive end use is desirable on the land surrounding a groundwater fed lake or pond to protect the quality of overland flow entering it. If other land uses are planned then surface water may have to be directed away from the pond.

Ponds to be stocked with cold water species can be less than 3m deep if there is an adequate and continuous flow of groundwater but otherwise the pond should have portions that are at least 4.5m deep. Warm water fish species (small and largemouth bass, catfish, perch, sunfish, rock bass) although more tolerant of poorer water quality still require a water body with enough flushing to avoid stagnation. Generally, if water levels are stable through the summer, then losses due to evaporation and infiltration are being replaced by groundwater and overland inflows and flushing rates should be sufficient. Average pond depths for warm water species should be 2-2.5m with some areas >4m deep to prevent winter kill of fish due to a lack of oxygen.

Part of the rehabilitation plan should include construction of shallow littoral zones for fish nursery areas and gravel spawning shoals on deeper shelves as shown in Figure J-3. An accurate estimate of the final water level after rehabilitation is necessary for success.

The best design will vary depending on the fish species of interest. Brook trout will spawn on gravel bottoms where there is groundwater upwelling. Smallmouth bass will reproduce on nearshore shoals where there is a mix of gravel sizes from pebbles to 10 cm diameter stones plus 10% fine sand all in a layer about 50 cm deep. These shoals should be located on the windward side of the water body so that wave action keeps them free of finer sediments.

Artificial structures such as submerged cribs, bank overhangs, and floating islands can be built to provide feeding and cover areas for fish.

Urbanization, agriculture and other human activities within watersheds have increasingly severed rivers and streams from their floodplain. Many species including fish, amphibians, waterfowl, and shorebirds are dependant on these interconnections between the river, floodplain pools and wetlands. Re-establishment of these connections is now recognized as an important part of watershed management. Aggregate extraction can play a vital role in creating these linkages. With properly planned rehabilitation the value of gravel deposits often found in large valleys can be used to finance the creation of floodplain pools, wetlands and other landscape features that will result in productive corridors of aquatic and upland communities. Carefully prepared site-specific designs are critical for success. Some Ontario examples include:

River Oaks (Waterloo)

* A former gravel pit was graded to create 22 residential estate lots.

* A cold water pond was created to collect and channel natural groundwater seepage on the property.
* A grassed swale system conducts surface runoff away from this pond.
* A stream flows from the cold water pond down to a floodplain pool which is connected to the Grand River.

In addition to creating steep faces and rocky slopes around the floodplain pool, a pike spawning habitat is planned once the final water levels can be predicted accurately.

Snyder Flats (Region of Waterloo)

* This active gravel pit is being progressively rehabilitated to enhance fish and wildlife habitat.
* It is located on a bend of the Grand River and is a large (100 ha) project which will help restore linkages between the river and its floodplain.
* The plans includes the creation of a cold water pond, maintained only by ground water, with a maximum depth of 5m.
* The total surface area has been kept small and banks on two sides fall steeply into deep water to help maintain the cool water temperatures.
* Shade trees will be planted at the top of these banks.
* A shallow littoral zone on the east shoreline will allow colonization by emergent and floating aquatic plants.
* The pond will be stocked with native cold water species.
* The two created floodplain pools will be maintained by controlled flow from the Grand River. They have been constructed with sinuous shorelines, large bays and islands which will provide a variety of habitats for wildlife.

A warm water pond (still being extracted) will be connected to the floodplain pools and be maintained by both surface water and groundwater. The large surface area of this pond will help maintain an average summer water temperature above 20 °C. The pond will serve as a warm water spawning area for northern pike, largemouth and smallmouth bass from the river.

APPENDIX K

ABANDONED PITS AND QUARRIES REHABILITATION FUND PROGRAM

ABANDONED PITS AND QUARRIES REHABILITATION FUND PROGRAM

Boyd Conservation Area (Rutherford Road, City of Vaughan) Abandoned Pit Pilot Rehabilitation Project

On Earth Day, April 22, 1991, the first pilot rehabilitation project for the Abandoned Pits and Quarries Rehabilitation Fund Program was initiated in an abandoned pit located in the Boyd Conservation Area of the Metropolitan Toronto and Region Conservation Authority. The project attracted the interest of four separate organizations that resulted in a partnership effort to rehabilitate the site. The four partners involved in the project were the Ministry of Natural Resources, the Aggregate Producers' Association of Ontario, the Conservation Council of Ontario and the Metropolitan Toronto and Region Conservation Authority. The Aggregate Producers' Association of Ontario lead the project and coordinated it through the services of Harrington and Hoyle Ltd. (landscape architects). At a public ceremony held on June 18, 1993, the site was pronounced rehabilitated.

Costs for the project were estimated to be as high as $300,000 to rehabilitate the 6 hectare site. In total, financial contributions from the partnership amounted to over $105,000 with the remaining costs for the project accounted for through donations of time, materials and labour by the various partners and public. Of the financial contributions, the Abandoned Pits and Quarries Rehabilitation Fund (MNR) contributed $61,400.

The partnership project provided the opportunity to experiment with a number of different rehabilitation techniques. Because the pit was located in the floodplain of the Humber River, it meant that simply grading the approximate 1.25:1 slope was not possible in order to comply with the Conservation Authority's requirement that no fill be placed in the floodplain. In an effort to virtually reduce erosion of materials from the exposed face without mechanically depositing them in the floodplain, the upper slope (above the face) was regraded to a 3:1 slope and contoured to divert the flow of surface water away from the face. The diverted flow is channelled around the face and eventually down into a created wetland area in the floodplain. Martin Earth Moving was the company hired to complete the grading and sloping requirements of the project.

As a measure of precaution during construction and as part of the partnership agreement, silt fencing was placed in strategic locations on the site to eliminate the possibilities of accidental sediment loading to the nearby Humber River. To assist the silt fencing, Pro-Seed donated and installed erosion control blankets as a test of their effectiveness in both germinating and controlling erosion.

Graded slopes were seeded with five different types of grass mixtures as a test of their ability to successfully germinate. The mixtures included:

1. Ministry of Transportation of Ontario Mixture (MTC Alternate - 55% Creeping Red Fescue, 27% Kentucky Blue Grass, 15% Perennial Rye and 3% White Cover) spread by the Conservation Authority at a rate of 72 kg/acre along with 7 bags of cellulose fibre mulch

2. Pickseed Company "Soil Stabilizer" mixture (10% White Clover, 15% Perennial Rye, 25% Tall Fescue, 15% Creeping Red Fescue, 15% Timothy and 10% Kentucky Blue Grass) spread by The Grass Company at a rate of approximately 150 kg/ha

3. Aimers Seed Company "Mini-Mow" mixture (Red Yarrow, Yellow Yarrow, Trefoil, White Clover, Alyssum and California Poppy (percentages not available)) spread by The Grass Company at a rate of approximately 10 lbs/1,000 square metres

4. Ministry of Natural Resources "Browning Rehabilitation Mix" (5% Yellow Clover, 5% Alsike Clover, 5% Birdsfoot Trefoil, 40% Hard Fescue, 15% Creeping Red Fescue, 15% Timothy and 15% Perennial Rye) spread by The Seed Company at a rate of approximately 150 kg/ha

5. Harrington and Hoyle's "H & H Rehabilitation Mix" (35% Perennial Rye, 20% Buckwheat, 10% Alfalfa, 5% White Clover, 15% Tall Fescue and 15% Creeping Red Fescue) spread by The Seed Company at a rate of approximately 150 kg/ha.

Although each of these mixtures appeared to germinate successfully, they will be monitored over the next few years to determine both the relative success rate of the mixtures and their component parts.

The created wetland was planted with various types of vegetation by the Conservation Council of Ontario. Species planted in the wetland included a variety of cattails, day lilies and irises. The Aggregate Producers' Association of Ontario also installed Wood Duck nesting boxes around the perimeter of the wetland. The wetland has proved to be a success in that the vegetation planted has become self sustaining and the diversity of wildlife both living in and using the wetland has been increasing over time.

Another rehabilitation initiative used in the project involved the creation of nine "pods" or "islands" of trees and shrubs on the upper slope. The theory behind the pods is that they provide immediate habitat potential for some species of wildlife and that eventually over time they will spread naturally resulting in further stabilization of the slope and increasing the biodiversity of the area. The various types of tree and shrub species used in the pods included Sumac, Scots Pine, Dogwood, Basswood, White Pine, Virginia Rose, Eastern Red Cedar, Hackberry, Coffeetree, White Cedar, Bittersweet, White Ash and Common Juniper. The creation and planting of the pods was a community event sponsored by the Aggregate Producers' Association of Ontario and involved volunteers from the public and the various partners involved in the project. Like the seed mixtures, the success of these pods will be monitored over the next few years.

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